BIOLOGY LIBRARY UCB

BIOLOGY LIBRARY UCB

Digitized by the Internet Archive
in 2007 with funding from
Microsoft Corporation

http://www.archive.org/details/naturalhistoryof01vogiuoft

SUBSCRIBERS' EDITION

SPECIALLY PREPARED FOR WILLIAM PATTISON.

THE
NATURAL HISTORY
OF
ANIMALS

(CLASS MAMMALIA—ANIMALS WHICH SUCKLE THEIR YOUNG),

IN WORD AND PICTURE.

By CARL VOGT, — AND — FRIEDRICH SPECHT,
PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF GENEVA. OF STUTTGART, THE DISTINGUISHED DELINEATOR OF ANIMAL LIFE.

TRANSLATED AND EDITED WITH ADDITIONS

By GEO. G. CHISHOLM, M.A., B.Sc., F.R.G.S.,
AUTHOR OF "THE WORLD AS IT IS;"
TRANSLATOR OF "SWITZERLAND; ITS SCENERY AND ITS PEOPLE" ETC.

ILLUSTRATED BY ABOVE THREE HUNDRED FINE ENGRAVINGS ON WOOD.

THE SCOPE OF THE WORK.—The present Work is devoted to the natural history of the animals that suckle their young, and in the account of them here given the pen of an eminent naturalist co-operates with the pencil of an equally eminent delineator of animal life to produce a view of the subject more satisfactory than what will be found in any previous publication. In this treatise the reader will find—along with admirable pictorial illustrations—a description of all the principal species, from such ponderous creatures as the elephant, the whale, and the hippopotamus, to the tiny mouse; from the bat that wings its way through the air, to the mole that burrows through the earth; from the apes and monkeys that have their four limbs furnished with hands, to the seal and walrus that have theirs in the shape of paddles, or the dolphin and porpoise that have no hind limbs at all; from the lion, tiger, wolf, and all their savage tribe, to the timid sheep and rabbit; from the many Mammals that bring forth their young differing but little in appearance from their parents, to the kangaroo that carries its immature young ones in a pouch, and the duckmole and echidna that hatch their young from eggs—all being portrayed in the most vivid manner, and their habits, appearance, and place in nature being set forth in sufficient detail.

THE INTEREST OF THE SUBJECT.—As to the inherent attractiveness of the subject thus dealt with little need be said, more especially in these days, when all branches of natural history are studied with the keenest enthusiasm; still, we may remark, that as the Mammalia comprise all those animals that are most useful to, and most closely associated with man, the department of Zoology here treated is, for readers in general, one that is invested with features of interest beyond all others.

THE AUTHOR AND THE TEXT.—The name of the distinguished naturalist Carl Vogt, who has long been recognized as one of the leaders of scientific thought and one of the masters of scientific exposition on the continent of Europe, is sufficient to stamp the work as one of high character, more especially when we know that it is a product of its author's mature years and extended studies. These studies have ranged over almost the entire field of natural science, and have embraced every department that is likely to shed light on the subject which he here discusses. Moreover, the author has not been a mere student of books and of museum specimens, but has himself visited the haunts of many of those animals which he describes, and consequently much of his information regarding their homes and their habits is given from personal observation. As a writer he has long been one of that brilliant band, so eminently characteristic of the present day, who seek to bring science to the knowledge of all, recognizing that it becomes most fruitful of good when it is most widely disseminated among the people.

THE POPULAR CHARACTER OF THE WORK.—The present account of the animals comprised in the class Mammalia will be found accordingly to possess a decidedly popular character, not popular, however, through lack of scientific value, but because the author presents the facts in an attractive form, and studies to smooth the path of those who can give only their leisure hours to learning the results of scientific research. The author's style is above all things clear, simple, and direct, and where occasion offers, lively and animated. The descriptions of the animals, though necessarily concise, are always adequate and interesting, and the matter of a more strictly scientific kind is adapted with great skill to the needs of those who have had no scientific training. The fact that this work has already appeared in a French and an Italian version, as well as in the original German, attests its popular character and the high esteem in which it is held. This, the only English version, has been prepared by a writer who has already manifested his ability as a translator and author.

ITS SCIENTIFIC VALUE.—As a description of the Mammalia—animals which suckle their young—written in the light of the most recent research, the work is of the highest value from a scientific point of view. While carefully refraining from burdening the text with details, the author selects from the stores of his knowledge those facts which are most significant and best suited to throw light on every topic that successively falls to be treated of. The methods of research and comparison followed by men of science are clearly and concisely brought out; and one who has really studied these volumes will have gained a scientific training of genuine value, besides having acquired a just idea of the place in nature of the Mammals as a class, and of the various orders and families of which, that class is made up. The geographical distribution of the various animals receives due attention, and the relations of living species to others now only known from fossil remains are frequently adduced.

THE TRANSLATOR'S ADDITIONS.—A number of additions, clearly distinguished from the author's text, have been made by the translator, consisting of graphic and interesting extracts from the works of some of the most observant travellers and others who have written on natural history. They have been selected with the view of imparting greater completeness to the mental picture which the reader may form of the animals described. In them adventures of travellers and sportsmen, and entertaining anecdotes, serve to exhibit a few of the best-known mammals in situations in which their native character is brought into relief.

THE ARTIST AND THE ILLUSTRATIONS.—The Illustrations (above 300 in number) are from the pencil of Friedrich Specht, the most eminent natural history painter at the present day. His success in the delineation of animal life arises not merely from long study and skill as an artist, but also from the fact that he is by education a naturalist. This qualification ensures two things which are so frequently wanting in the works of animal painters who are not naturalists. It enables us to rely on the accuracy of character and detail, so essential to scientific truth in pictorial representations of members of the animal kingdom; and it is a voucher for the fidelity with which the action and behaviour of the animals have been depicted—amidst surroundings appropriate to them in their free life—in the woods and forests, on mountains or plains, on land or in water. The artist has portrayed—and that in the most spirited manner—the animals as they appear in the varied circumstances of real life, in quest of their prey, caressing their young ones, or sporting with their fellows. The engravings have been executed in the most careful and finished manner, under Mr. Specht's own direction.

INDEX AND GLOSSARY.—A copious *Index* will be furnished, by the use of which the details regarding any animal may be ascertained by referring either to its scientific or its vernacular name. A pictorially illustrated *Glossary* will likewise be supplied, explaining the scientific words employed, though most of these are briefly defined in the text, and that generally the first time they are used.

CONDITIONS.—The book will be printed in the finest manner, on highly finished paper, made expressly for it, and will form two handsome quarto volumes. It will be illustrated by forty full-page separate engravings, and two hundred and sixty-four printed in the text. The Work will be issued in two handsome volumes, cloth extra, gilt edges, 48*s.*; and also in full morocco, gilt extra, 5 guineas.

BLACKIE & SON, LIMITED; LONDON, GLASGOW, EDINBURGH, AND DUBLIN.

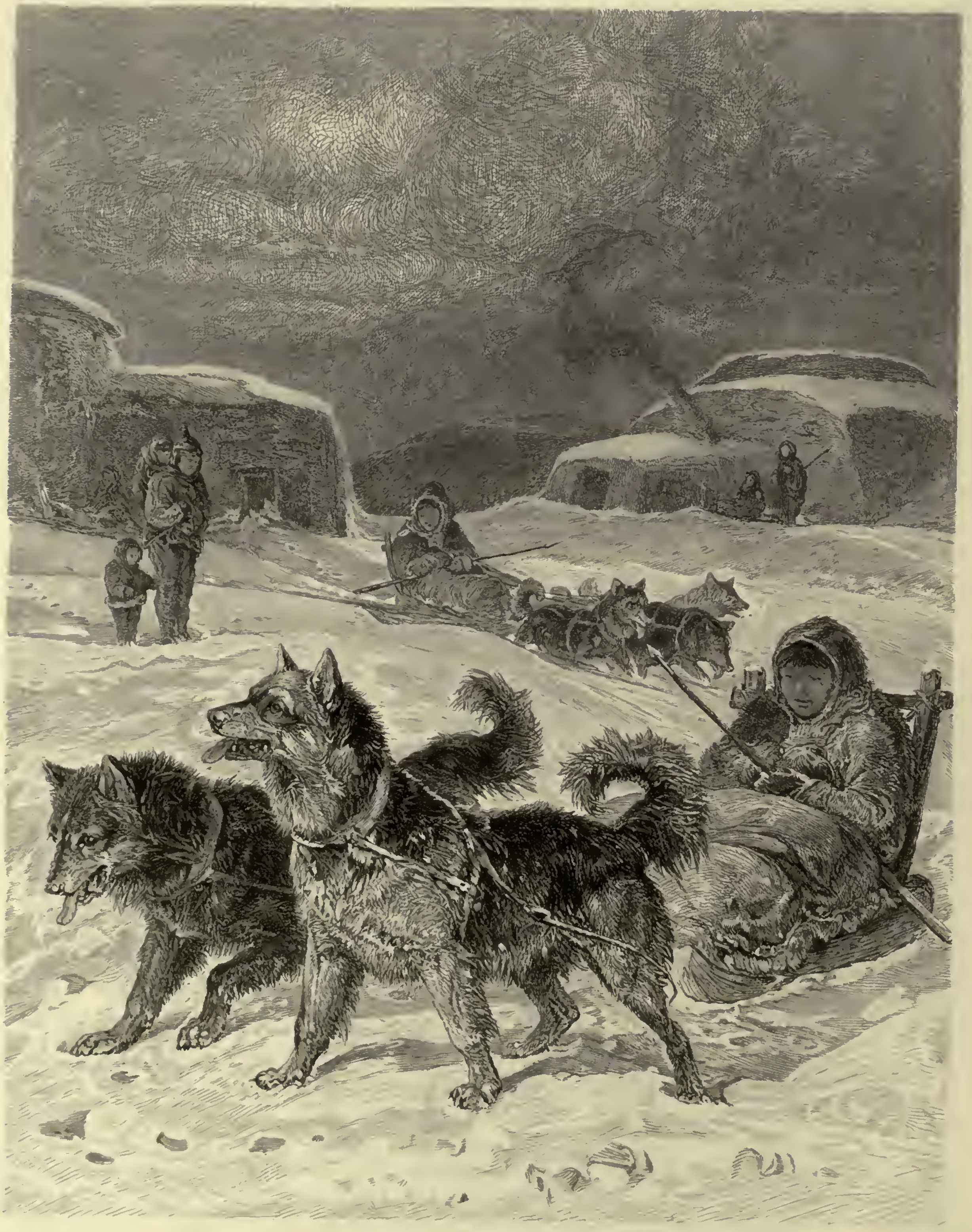
PUBLISHING EXCLUSIVELY BY SUBSCRIPTION.

THE

NATURAL HISTORY OF ANIMALS

[CLASS MAMMALIA].

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA



ESKIMO DOG. (*Canis familiaris borealis*)

Frontis Vol I

THE
NATURAL HISTORY
OF
ANIMALS

(CLASS MAMMALIA—ANIMALS WHICH SUCKLE THEIR YOUNG),

IN WORD AND PICTURE.

BY CARL VOGT, — AND — FRIEDRICH SPECHT,
PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF GENEVA, OF STUTTGART, THE DISTINGUISHED DELINEATOR OF ANIMAL LIFE.

TRANSLATED AND EDITED WITH ADDITIONS
BY
GEORGE G. CHISHOLM, M.A., B.SC., F.R.G.S.
AUTHOR OF "THE WORLD AS IT IS;"
TRANSLATOR OF "SWITZERLAND: ITS SCENERY AND ITS PEOPLE;" ETC.

VOL. I.

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

LONDON:
BLACKIE & SON, LIMITED, 49 & 50 OLD BAILEY, E.C.
GLASGOW AND EDINBURGH.

fQL703
V6
v.1

BIOLOGY
LIBRARY
G

GENERAL

PREFACE.

The work here submitted to the English public is a translation of one that has already appeared in three languages, German, French, and Italian. The intrinsic interest of the subject, the character of the text, which is from the pen of a distinguished naturalist long recognized as a master in scientific exposition, and the character of the illustrations, which are the work of the most eminent natural-history painter now living, quite account for its having earned this distinction, and will no doubt make the work welcome in an English dress.

With regard to the English edition a few words of explanation are necessary. While the English text is in the main a translation from the German, it is the duty of the translator to explain a few differences that will be found between it and the original from which the translation was made.

In the first place it ought to be stated that the French, as well as the Italian version, is from the hand of the author himself, and both of these are hence entitled to be regarded as original works. Occasionally, therefore, the translator, while following the German as a rule, has felt himself at liberty to adopt modifications introduced by the author into the French version.

Another difference will be found in the naming of the animals described. While, as in duty bound, the translator has always given the scientific names used by the author himself, he has in many cases added other scientific names which are more commonly applied to the same animals by English naturalists, and by which accordingly the animals spoken of are likely to be more easily identified by English readers. These additional names are distinguished by being inclosed in subordinate parentheses after the names used by the author. Where a different name is added only for the genus or the species, that name is given after the generic or specific name used by Vogt. For example, "*Rhyzæna* (*Suricata*) *tetradactyla*" means that the animal referred to by Vogt as *Rhyzæna tetradactyla* is the *Suricata tetradactyla* of other naturalists, and "*Ursus ferox* (*horribilis*)" means that the animal called *Ursus ferox* by Vogt is the same as that known to others as *Ursus horribilis.* Where both generic and specific names are different the entire alternative name of the animal is given after that used by the author, thus "*Lebtonyx monachus* (*Monachus albiventer*)" means that the *Leptonyx monachus* of Vogt is the *Monachus albiventer* of other writers. In furnishing an alternative scientific name the translator has chiefly had in view the practical aim of enabling readers to identify the animal described with animals exhibited in the gardens of the Zoological Society of London; and accordingly, where an animal is to be found in the catalogue printed for the Society under the title of "List of the Vertebrated Animals now or lately living in the Gardens of the Zoological Society of London" (eighth edition, 1883), he has added the scientific name used in that list, except where the animal can easily be found in it by means of the popular name. In other cases the names used in well-known English works have been added; and additional vernacular names have sometimes been given from Sterndale's "Mammals of India and Ceylon," Gould's "Mammals of Australia," Elliott Coues' "Report upon the Collections of the Mammals of the United States," and other works.

The account of the recent observations on the development of the Monotremes, made since the writing of the German and French versions of the work, has been translated from manuscript corrections kindly furnished by the author.

A more serious divergence from the original will be found in the Introduction, in which a few paragraphs have been interpolated by the translator, for the purpose of making the context more easily understood by readers who may be wholly unacquainted with natural history. In making these additions, however, the translator has carefully adhered to the sense of the writer of the original work.

The translator is likewise responsible for the compilation of the Glossary, and for the selection of the extracts from the works of travellers and naturalists, containing narratives of adventure and additional particulars relating to the habits of the animals described. These insertions are distinguished from the other matter by being inclosed in brackets and printed in smaller type.

GEO. G. CHISHOLM.

THE PICTURES.

FULL-PAGE PICTURES.

PLATE — To face page
I. The Chimpanzee (Troglodytes niger), . . . 32
II. The Gorilla (Troglodytes gorilla), . . . 34
III. The Orang-utang or Mias (Simia satyrus), . . . 36
IV. Green Guenons (Cercopithecus sabæus) plundering a Maize-field, . . . 48
V. Group of Java Monkeys (Macacus cynomolgus), . . . 50
VI. Wolves (Canis lupus) in pursuit of Prey, . . . 136
VII. Striped Hyænas (Hyæna striata) and Jackals (Canis aureus), . . . 154
VIII. The Barbary Lion (Felis leo); . . . 162
IX. The Senegal Lion (Felis leo), . . . 164
X. The Leopard (Felis leopardus), . . . 168
XI. The Jaguar (Felis onca), . . . 176
XII. The Polar Bear (Ursus maritimus), . . . 204
XIII. The Common or Brown Bear (Ursus arctos), . . . 206
XIV. A Wolverene or Glutton (Gulo borealis) attacking a Reindeer, . . . 218
XV. The Walrus or Morse (Trichechus rosmarus), . . . 252

PICTURES IN THE TEXT.

FIG. — PAGE
1. The Hoolock (Hylobates leuciscus), . . . 41
2. The White-handed Gibbon (Hylobates lar), . . . 43
3. Entellus Monkeys (Semnopithecus entellus), . . . 45
4. The Proboscis Monkey or Kahau (Semnopithecus nasica), . . . 46
5. The Guereza (Colobus guereza), . . . 47
6. The Diana Monkey (Cercopithecus diana), . . . 49
7. Group of Rhesus Monkeys (Macacus rhesus), . . . 50
8. The Wanderoo (Macacus silenus), . . . 51
9. The Barbary Ape (Inuus ecaudatus), . . . 52
10. The Black Ape (Cynocephalus niger), . . . 55
11. The Gelada (Cynocephalus gelada), . . . 56
12. The Common Baboon (Cynocephalus Babuin), . . . 58
13. The Mandrill (Cynocephalus Maimon), . . . 59
14. Red Howling Monkeys (Mycetes seniculus), . . . 63
15. The Barrigudo (Lagothrix Humboldti), . . . 64
16. The Miriki Spider-monkey (Ateles eriodes), . . . 65
17. The Weeper Capuchin or Sai (Cebus capucinus), . . . 66
18. The Couxio or Black Saki (Pithecia Satanas), . . . 67
19. The Ouakari (Brachyurus calvus), . . . 68
20. The Masked Callithrix (Callithrix personata), . . . 68
21. Saimiri or Squirrel-monkey (Chrysothrix sciurea), . . . 69
22. The Mirikina or Three-banded Douroucouli (Nyctipithecus trivirgatus), . . . 70
23. The Silky Marmoset (Hapale rosalia), . . . 71
24. The Ouistiti or Marmoset (Hapale Jacchus), . . . 72
25. Ring-tailed Lemur (Lemur catta), . . . 81
26. The Dwarf Lemur (Microcebus myoxinus), . . . 81
27. The Gray Lemur (Hapalemur griseus), . . . 82
28. The Waluvi or Forked-crowned Mouse Lemur (Chirogaleus furcifer), . . . 83
29. The Indris or Babakoto (Lichanotus Indris), . . . 84
30. The Aye-aye (Chiromys madagascariensis), . . . 85
31. The Potto (Pterodicticus Potto), . . . 87
32. The Angwantibo (Arctocebus calabarensis), . . . 88
33. The Common Galago (Otolicnus Galago), . . . 89
34. The Slow-paced Lemur or Slender Loris (Stenops gracilis), . . . 90
35. The Spectre-tarsier (Tarsius spectrum), . . . 91
36. The Colugo or Flying-cat (Galeopithecus volitans), 93
37. The Kalong (Pteropus edulis), . . . 102
38. The Long-eared Bat (Plecotus auritus), . . . 104
39. The Barbastelle or Pug-nose Bat (Synotus barbastellus), . . . 104

FIG. PAGE
40. The Water-bat (Vespertilio Daubentoni), . . 105
41. The Noctule (Vesperugo noctula), ... 106
42. The Pipistrelle or Dwarf Bat (Vesperugo pipistrellus), ... 107
43. The Flap-nosed Bat (Rhinopoma microphyllum), . 108
44. The Vampire Bat (Phyllostoma spectrum), . . 109
45. The Greater Horse-shoe Bat (Rhinolophus ferrum-equinum), ... 110
46. The Banxring or Tana (Cladobates Tana), . . 115
47. The Elephant-shrew (Macroscelides typicus), . 115
48. The Wuychuchol (Myogale moschata), . . . 116
49. The Garden-shrew (Crocidura aranea), . . . 118
50. The Water-shrew (Crossopus fodiens), . . . 119
51. The Agouta or Almiqui (Solenodon paradoxum), . 120
52. The Tanrec (Centetes ecaudatus), ... 121
53. A Family of Hedgehogs (Erinaceus europæus), . 123
54. The Common Mole (Talpa europæa), . . . 124
55. The Star-nosed Mole (Condylura cristata), . . 125
56. The Cape Golden Mole (Chrysochloris capensis), . 126
57. The African Wolf (Canis lupaster), . . . 138
58. The Maned Wolf (Canis jubatus), ... 139
59. The Coyote or Prairie-wolf (Canis latrans), . . 140
60. The Slender Jackal (Canis anthus), . . . 141
61. The Dingo (Canis dingo), ... 143
62. The Black-backed Jackal (Canis mesomelas), . 145
63. The Aguarachay (Canis Azaræ), ... 146
64. The Fox (Canis vulpes), ... 147
65. The Corsac (Canis corsac), ... 148
66. The White or Arctic Fox (Canis lagopus), . . 149
67. The Sahara Fox or Fennek (Canis zerda), . . 150
68. Viverra Dog or Tanuki (Nyctereutes viverrinus), . 151
69. The Long-eared Fox (Otocyon caffer), . . . 152
70. The Cape Hunting-dog (Lycaon pictus), . . 153
71. The Spotted Hyæna (Hyæna crocuta), . . . 156
72. The Earth-wolf or Aardwolf (Proteles Lalandii), . 157
73. Fahhad or Maneless Hunting-leopard (Cynailurus guttatus), ... 161
74. The Tiger (Felis tigris), ... 167
75. The Clouded Tiger (Felis macroscelis), . . . 169
76. The Marbled Cat (Felis marmorata), . . . 171
77. The Gloved or Fallow Cat (Felis maniculata), . 172
78. The Wild Cat (Felis catus), ... 173
79. The Viverrine Cat (Felis viverrina), . . . 174
80. The Serval (Felis Serval), ... 175
81. The Puma or Cougar (Felis concolor), . . . 177
82. The Ocelot (Felis pardalis), ... 178
83. The Pampas Cat (Felis pajeros), ... 179
84. The Eyra (Felis eyra), ... 180

FIG. PAGE
85. The Caracal (Lynx Caracal), ... 182
86. The Polar Lynx (Lynx vulgaris), ... 183
87. The Spanish Lynx (Lynx pardinus), . . . 184
88. The Fossa (Cryptoprocta ferox), ... 185
89. The Common Genet (Genetta vulgaris), . . 187
90. The African Civet-cat (Viverra Civetta), . . 188
91. The Asiatic or Indian Civet (Viverra Zibetha), . 189
92. The Delundung or Linsang (Prionodon gracilis), . 190
93. The Paradoxure or Palm-cat (Paradoxurus typus), 191
94. The Mampalon (Cynogale Bennettii), . . . 192
95. The Egyptian Ichneumon or Pharaoh's Rat (Herpestes Ichneumon), ... 193
96. The Mongoose or Gray Ichneumon (Herpestes griseus), ... 194
97. The Suricate (Rhyzæna tetradactyla), . . . 195
98. The Cacamizli (Bassaris astuta), ... 198
99. The Common Raccoon (Procyon lotor), . . 199
100. The Social Coati (Nasua socialis), . . . 200
101. The Kinkajou (Cercoleptes caudivolvulus), . . 201
102. The Binturong (Arctictis binturong), . . . 202
103. The Panda (Ailurus fulgens), ... 203
104. Ailuropus melanoleucus, ... 204
105. The Black Bear (Ursus americanus), . . . 208
106. The Malayan Bear (Ursus malayanus), . . 209
107. The Indian Black Bear (Ursus labiatus), . . 210
108. The Common Badger (Meles taxus), . . . 214
109. The Telagon (Mydaus Telagon), ... 215
110. The Cape Ratel (Ratelus capensis), . . . 216
111. The Brazilian Skunk (Mephitis suffocans), . . 217
112. The Bush-dog (Icticyon venaticus), . . . 219
113. The Tayra (Galictis barbara), ... 220
114. The Pine-Marten (Mustela martes), . . . 221
115. The Beech-Marten (Mustela foina), . . . 222
116. The Sable (Mustela zobellina), ... 223
117. The Polecat (Putorius fœtidus), ... 224
118. The Ferret (Putorius furo), ... 225
119. The Common Stoat (Putorius erminea), . . 226
120. The Weasel (Putorius vulgaris), ... 227
121. The European Vison (Putorius lutreola), . . 228
122. The Lynx-tooth (Lyncodon patagonicus), . . 229
123. The Otter (Lutra vulgaris), ... 231
124. The Sea-otter (Enhydris marina), ... 232
125. Steller's Sea-lion (Otaria Stelleri), ... 243
126. The Sea-bear (Otaria ursina), ... 245
127. The Sea-elephant (Cystophora proboscidea), . 247
128. The Bladder-nosed Seal (Cystophora cristata), . 248
129. The Sea-leopard (Leptonyx leopardinus), . . 249
130. The Greenland Seal (Phoca grœnlandica), . . 250

THE CONTENTS.

INTRODUCTION.

PAGE
General Characters of the Vertebrata, ... 1
Different Types of the Vertebrata, ... 1
Comparison of Vertebrate Types, ... 2
Position of the Mammalia in the Sub-kingdom Vertebrata, ... 2
The Mammalian Structure, ... 2
  General Characters, ... 2
  Special Characters:
    The Skin and its Modifications, Hair, Nails, Superficial Glands, Milk Glands, ... 2
    The Skeleton: Skull, Limbs, Shoulder-girdle, Fore- and Hind-limbs, the Hand; Position of the Limbs in Walking, ... 4
    The Teeth: their Structure, Milk and Permanent Teeth, Dental Formulæ, Perfecting of the Dental Systems during the Evolution of the Ancestry of the present Mammals, . . . 6
Reproduction in the Mammalia, ... 11
Distribution in Space of the Mammalia, ... 12
Subdivision of the Mammals based on the presumed order of Evolution, ... 14
Presumable Relations of existing Placental Orders to a Marsupial Ancestry as shown by the Dental Characters, ... 16
Table of the Orders, Families, and Tribes of the Mammalia, ... 18
Note on Geological Points referred to in this Work, . 22
Geological Table of the Main Rock-systems into which the Crust of the Earth is divided, ... 23

APES AND MONKEYS (SIMIÆ).

Introduction, ... 25
Monkeys of the Old World (Catarrhinæ), ... 32
  Anthropoid Apes (Anthropomorphæ), ... 32
    Black Anthropoid Apes (*Troglodytes*), ... 32
      Chimpanzee (Troglodytes niger), ... 33
      Chego (Troglodytes Tchego), ... 35
      Gorilla (Troglodytes gorilla), ... 35
    Red Anthropoid Apes (*Simia*), ... 36
      Orang-utang or Mias (Simia satyrus), . . . 36
PAGE
    Gibbons (*Hylobates*), ... 39
      Siamang (Hylobates syndactylus), ... 40
      Hoolock (Hylobates leuciscus (hoolock)), . . 41
      White-handed Gibbon (Hylobates lar), . . . 42
  Tailed Monkeys (Caudatæ), ... 42
    Semnopitheci, ... 46
      Entellus Monkey or Hunuman (Semnopithecus entellus), ... 46
      Proboscis Monkey or Kahau (Semnopithecus nasica), ... 47
    Colobi, ... 48
      Guereza (Colobus guereza), ... 48
    The Guenons (*Cercopithecus*), ... 48
      Talapoin (Myiopithecus talapoin), ... 48
      Diana Monkey (Cercopithecus diana), . . . 48
      Mona (Cercopithecus mona), ... 48
      Mangabey or Moorish Monkey, ... 48
      Hussar or Nisnas Monkey (Cercopithecus pyrrhonotus), ... 48
      Green Guenon (Cercopithecus sabæus), . . . 49
    Macaques (*Macacus*), ... 49
      Java Monkey (Macacus cynomolgus), . . . 51
      Boonder (Macacus rhesus), ... 51
      Wanderoo (Macacus silenus), ... 51
      Magot (Inuus ecaudatus), ... 52
    Baboons (*Cynocephalus*), ... 53
      Black Ape (Cynocephalus niger), ... 55
      Gelada (Cynocephalus gelada), ... 55
      Arabian Baboon (Cynocephalus hamadryas), . 55
      Common Baboon (Cynocephalus Babuin), . . 57
      Chacma or Pig-faced Baboon (Cynocephalus porcarius), ... 57
      Guinea Baboon (Cynocephalus sphinx), . . . 57
      Mandrill (Cynocephalus Maimon), ... 59
      Drill (Cynocephalus leucophæus), ... 59
Monkeys of the New World (Platyrrhinæ), ... 60
  Naked-tailed Monkeys (Gymnuræ), ... 62
    The Howlers (*Mycetes*), ... 62
      Red Howling Monkey (Mycetes seniculus), . . 63
    The Woolly Monkeys (*Lagothrix*), ... 64
      Barrigudo (Lagothrix Humboldti), ... 64
    The Spider-monkeys (*Ateles*), ... 64
      Miriki (Ateles criodes), ... 64

PAGE
THE SAJOUS (Cebidæ), 65
Weeper Capuchin (Cebus capucinus), 66
THE SAKIS (Aneturæ), 66
Couxio or Black Saki (Pithecia Satanas), 67
Ouakari (Brachyurus calvus), 67
Masked Callithrix (Callithrix personata), 68
Saimiri or Squirrel-monkey (Chrysothrix sciurea), 69
Mirikina (Nyctipithecus trivirgatus), 70
Clawed Monkeys (Arctopitheci), 70
Silky Marmoset (Hapale rosalia), 72
Ouistiti or Common Marmoset (Hapale Jacchus), 73
Geographical Distribution and Descent of the Apes and Monkeys, 73

THE PROSIMIANS (PROSIMII).

Introduction, 77
THE PROSIMIANS OF MADAGASCAR, 80
The Lemurs (Lemurida), 80
Ring-tailed Lemur (Lemur catta), 83
Dwarf Lemur (Microcebus myoxinus), 83
Gray or Broad-nosed Lemur (Hapalemur griseus), 83
Waluvi (Chirogaleus furcifer), 84
The Indris Family (Indrisida), 84
Indris or Babakoto (Lichanotus Indris), 85
The Aye-aye, 86
Aye-aye (Chiromys madagascariensis), 86
THE AFRICAN PROSIMIANS, 87
The Potto Family (Pterodictida), 87
The Potto (Pterodicticus Potto), 87
Angwantibo (Arctocebus calabarensis), 87
The Galagos (Galagonida), 88
Grand or Thick-tailed Galago (Otolicnus crassicaudatus), 88
Komba (Otolicnus agisymbanus), 89
Galago proper (Otolicnus Galago), 89
THE EAST INDIAN PROSIMIANS, 89
The Loris (Lorisida), 89
Plump Loris (Stenops tardigradus), 90
Slow-paced Lemur (Stenops gracilis), 90
The Spectre-tarsier (Tarsius spectrum), 92
The Colugos (Galeopithecida), 93
Colugo or Flying-cat (Galeopithecus volitans), 94
Geographical Distribution and Descent of the Prosimians, 94

THE BATS (CHIROPTERA).

Introduction, 96
FRUIT-EATING BATS (Carpophaga), 101
Flying-foxes (Pteropida), 101
Kalong (Pteropus edulis), 102
INSECT-EATING BATS (Entomophaga), 103
True Bats or Vespertilionidæ (Gymnorhina), 103
Long-eared Bat (Plecotus auritus), 104
PAGE
Barbastelle or Pug-nose Bat (Synotus barbastellus), 105
Common Mouse-coloured Bat (Vespertilio murinus), 105
Water-bat (Vespertilio Daubentoni), 105
Noctule (Vesperugo noctula), 106
Pipistrelle or Dwarf Bat (Vesperugo pipistrellus), 106
Leaf-nosed Bats (Phyllostomata), 107
Flap-nosed Bat (Rhinopoma microphyllum), 107
True Vampire (Phyllostoma spectrum), 108
Horse-shoe Bats of the Old World, 109
Lesser Horse-shoe Bat (Rhinolophus hipposideros), 110
Greater Horse-shoe Bat (Rhinolophus ferrum-equinum), 110
Geographical Distribution and Descent of the Bats, 110

THE INSECT-EATERS (INSECTIVORA).

Introduction, 112
BANXRINGS OR CLIMBERS (Tupaiæ), 114
Tana or Banxring (Cladobates Tana), 114
THE JUMPING-SHREWS (Macroscelida), 115
Elephant-shrew (Macroscelides typicus), 116
Algerian Jumping-shrew (Macroscelides Rozeti), 116
THE DESMANS OR DIVERS (Myogalida), 116
Wuychuchol (Myogale moschata), 116
Desman (Myogale pyrenaïca), 116
THE SHREWS OR RUNNERS (Soricida), 117
Garden-shrew (Crocidura aranea), 118
Water-shrew (Crossopus fodiens), 118
Agouta or Almiqui (Solenodon paradoxum), 120
THE CRAWLERS, 120
The Tanrecs (Centetida), 120
Tanrec (Centetes ecaudatus), 121
Gymnura Rafflesii, 121
The Hedgehogs (Erinacei), 121
Hedgehog (Erinaceus europæus), 122
THE BURROWERS, 122
The Moles (Talpida), 123
Common Mole (Talpa europæa), 123
Star-nosed Mole (Condylura cristata), 125
Scalops canadensis, 125
Group of the Golden Moles (Chrysochlorida), 125
Geographical Distribution and Descent of the Insect-eaters, 126

THE FLESH-EATERS (CARNIVORA).

Introduction, 129
The Dog Tribe (Canida), 134
THE DOGS PROPER (Canis), 137
Group of the Wolves (sub-genus *Lupus*), 137
Common Wolf (Canis lupus), 137
African Wolf (Canis lupaster), 139

PAGE
Maned Wolf (Canis jubatus), ... 139
Coyote or Prairie-wolf (Canis latrans), . . 140
Jackal or Dib (Canis aureus), ... 141
Slender Jackal (Canis anthus), ... 141
The Domestic Dog, ... 142
The Dingo (Canis dingo), ... 144

Group of the Foxes (sub-genus *Vulpes*), ... 144
Black-backed Jackal (Canis mesomelas), . . 145
Aguarachay (Canis Azaræ), ... 145
Fox (Canis vulpes), ... 146
Corsac (Canis corsac), ... 148
White or Arctic Fox (Canis lagopus), . . . 149
Sahara Fox or Fennek (Canis zerda), ... 150
Viverra Dog or Tanuki (Nyctereutes viverrinus), 151
Long-eared Fox (Otocyon caffer), ... 152
Cape Hunting-dog (Lycaon pictus), . . . 152

The Hyænas (Hyænida), ... 154
Striped Hyæna (Hyæna striata), ... 156
Spotted Hyæna (Hyæna crocuta), ... 157
Brown Hyæna (Hyæna brunnea), ... 157
Earth-wolf or Aardwolf (Proteles Lalandii), . 157

The Cat Tribe (Felida), ... 158
The Cheetahs or Hunting-leopards (Cynailurus, ... 162
Fahhad or Maneless Hunting-leopard (Cynailurus guttatus), ... 162
Cheetah (Cynailurus jubatus), ... 162
The True Felines (Felis), ... 163
Felines of the Old World, ... 163
Lion (Felis leo), ... 163
Tiger (Felis tigris), ... 165
African Panther (Felis Leopardus), . . . 168
Asiatic Panther (Felis Panthera), ... 168
Clouded Tiger (Felis macroscelis), ... 170
Marbled Cat (Felis marmorata), ... 170
Fallow or Gloved Cat (Felis maniculata), . . 171
The Domestic Cat, ... 171
Wild Cat (Felis catus), ... 172
Viverrine Cat (Felis viverrina), ... 174
Serval (Felis Serval), ... 174
Felines of the New World, ... 175
Jaguar (Felis onca), ... 175
Cougar or Puma (Felis concolor), ... 176
Ocelot (Felis pardalis), ... 179
Pampas Cat (Felis pajeros), ... 180
Brazilian Eyra (Felis eyra), ... 180
Jaguarondi (Felis jaguarondi), ... 180
The Lynxes (Lynx), ... 180
Booted Lynx (Lynx caligatus), ... 181
Caracal (Lynx Caracal), ... 182
Polar Lynx (Lynx vulgaris), ... 182
Spanish Lynx (Lynx pardinus), ... 183
The Fossa (Cryptoprocta ferox), ... 184

The Viverrines (Viverrida), ... 186
The Civets (Ailuropoda), ... 188
Common Genet (Genetta vulgaris), ... 188
Civet Cats (Viverra Civetta and Zibetha), . . 189
Delundung or Linsang (Prionodon gracilis), . 190
Paradoxures or Musangs (Paradoxurus), . . 190
Common Paradoxure (Paradoxurus typus), . 191
Mampalon (Cynogale Bennettii), ... 191
The Mangoustis (Cynopoda), ... 192
True Mangoustis (Herpestes), ... 192
Egyptian Ichneumon (Herpestes Ichneumon), . 193
Gray Ichneumon or Mongoose (Herpestes griseus), 194
Suricate (Rhyzæna tetradactyla), ... 195

The Bears (Ursida), ... 196
The Small Bears (Subursida, ... 198
Cacamizli (Bassaris astuta), ... 198
Crab-eating Raccoon (Procyon cancrivorus), . 198
Mexican Raccoon (Procyon Hernandezi), . . 198
Common Raccoon (Procyon lotor), ... 198
Coatis or Proboscis-bears (Nasua), ... 199
Social Coati (Nasua socialis), ... 201
Kinkajou (Cercoleptes caudivolvulus), . . . 202
Binturong (Arctictis binturong), ... 202
Panda (Ailurus fulgens), ... 203
Ailuropus melanoleucus, ... 204
The Large Bears (Ursida), ... 204
Polar Bear (Ursus maritimus), ... 205
Gray Bear or Grizzly (Ursus ferox), . . . 206
Brown Bear (Ursus arctos), ... 207
Black Bear (Ursus americanus), ... 209
Coco-nut Palm Bear (Ursus malayanus), . . 210
Indian Black Bear or Sloth-bear (Ursus labiatus), 210

The Badger and Weasel Family (Mustelida), . . 211
Group of the Badgers (Melida), ... 213
Common Badger (Meles taxus), ... 213
American and Indian Badgers, ... 216
Telagon or Stinking Badger (Mydaus Telagon), 216
Honey-badgers (Ratelus or Mellivora), . . 217
Cape Ratel (Ratelus capensis), ... 217
Skunks (Mephitis), ... 217
Brazilian Skunk (Mephitis suffocans), . . 218
Group of the Martens (Martida), . . . 218
Glutton (Gulo borealis), ... 218
Bush-dog (Icticyon venaticus), ... 219
Hyrares or Grisons (Galictis), ... 219
Tayra (Galictis barbara), ... 220
Grison (Galictis vittata), ... 220
Martens (Mustela), ... 220
Pine Marten (Mustela martes), ... 221
Beech or Stone Marten (Mustela foina), . . 222
Sable (Mustela zobellina), ... 223
American Marten (Mustela americana), . . 224
Pekan or Canadian Marten (Mustela Pennanti), 224
Polecats (Putorius), ... 224
Polecat (Putorius fœtidus), ... 225
Ferret (Putorius furo), ... 225
Tiger Polecat (Putorius sarmaticus), . . . 226
Weasels (sub-genus Gale), ... 226
Common Stoat or Ermine (Putorius erminea), . 226
Weasel proper (Putorius vulgaris), . . . 227
Visons (sub-genus Lutreola), ... 227
Siberian Vison (Putorius sibiricus), . . . 228
European Vison (Putorius lutreola), . . . 228
American Vison or Mink (Putorius vison), . 228
Lynx-tooth (Lyncodon patagonicus), . . . 229
Group of the Otters (Lutrida), ... 229
European Otter (Lutra vulgaris), ... 229
Sea-otter (Enhydris marina), ... 231

PAGE
Geographical Distribution and Descent of the Flesh-eaters, ... 234

THE SEALS (PINNIPEDIA).

Introduction, ... 239
THE EARED SEALS (Otarida), ... 241
Steller's Sea-lion (Otaria Stelleri), . . . 243
Sea-bear (Otaria ursina), ... 244
PAGE
THE TRUE SEALS (Phocida), ... 246
Sea-elephant (Cystophora proboscidea), . . 246
Bladder-nosed Seal (Cystophora cristata), . . 248
Monk-seal (Leptonyx monachus), . . . 249
Sea-leopard (Leptonyx leopardinus), . . . 249
Common Seal or Sea-calf (Phoca vitulina), . 249
Greenland Seal (Phoca grœnlandica), . . 249
THE WALRUS OR MORSE (Trichechus rosmarus), . 250
Geographical Distribution and Descent of the Seals, . 253

Young of the Brown Bear.

RARY
VERSITY
OF
IFORNIA

THE

NATURAL HISTORY OF ANIMALS

[CLASS MAMMALIA].

INTRODUCTION.

THE shortest definition of this important class of the animal kingdom, to which man himself belongs, is as follows: vertebrates with hair and with milk-glands for the first nourishment of the young. It is likewise a definition that gives the only absolutely exclusive characters of the class, for no other group of vertebrates has hair or milk-glands.

General Characters of the Vertebrata.—The mammals are in the first place true vertebrates, for, like all the other animals belonging to this sub-kingdom, fishes, amphibians, reptiles, and birds, they have an internal skeleton which forms the axis of the body, and which is composed of a column of separate vertebræ. This vertebral column is crowned by the skull, which contains the brain and the principal organs of sense, and it has in addition two pairs of lateral appendages, namely the fore- and the hind-limbs. This skeleton, which in the higher vertebrates is always formed of bones, is enveloped by muscles which are attached to its individual parts, and these parts thus perform the function of levers on which the muscles act in contracting. In most other animals the muscles are attached to the more or less hard skin or external covering. But the skeleton also forms the axis of the body, which is so divided by it that we have on the back (namely in a tube behind or above the solid centres of the vertebræ) the central nervous system, that is, the brain and the spinal column, and on the abdominal side the other organs, those serving for the development of the animal, namely the alimentary system and the organs of respiration and reproduction. Moreover, the skeleton also forms a number of cavities, in which the organs are sometimes so much embedded as to lie in perfectly closed capsules, as is the case, for example, with the brain.

None of the Vertebrata have more than two pairs of limbs, a fore and a hind pair; and this also is an essential point of distinction as compared with other animals, for in every other sub-kingdom the limbs or motor appendages, if present at all, are always found in greater number. These limbs may be only in a rudimentary condition or even altogether absent, but their number can never be increased.

Different Types of the Vertebrata.—If now we take a glance at the different types of vertebrates with the view of comparing them together, we observe at once a sharp line of demarcation in the terminations of the limbs. In the fishes the limb ends in a considerable number of rays, while in all other living vertebrates the terminal portion of the limbs never has more than five fingers or toes, or, to use the general term employed by men of science, *digits*. The fishes accordingly are many-fingered; amphibians, reptiles, birds, and mammals, on the other hand, five-fingered (or five-toed). The number of these fingers or toes may be reduced in the process of development, but every limb in all members of the classes named has always five digits to begin with. This is a fact of great importance. We may deduce from it that vertebrates with a smaller number of digits must be descended from five-fingered or five-toed ancestors, and that those which have five digits on each limb have undergone no modification, but have preserved their original type.

Comparison of Vertebrate Types: Ichthyopsida and Sauropsida.—The five-toed vertebrates when compared with one another show some very remarkable points of resemblance and difference. The amphibians (frogs, toads, &c.) have a number of characters in common with the fishes. Types may be found in regard to which, apart from the structure of the limbs, doubt might be entertained as to whether we should refer them to the one class or the other. These two classes have accordingly been rightly comprehended in one larger group—the **Ichthyopsida,** a group the members of which breathe, sometimes during their whole life, sometimes only in the larval condition, through true gills, which are never developed in the other three classes.

A number of common characters unite also the reptiles and birds. As to the fact that the ancestors of the birds were reptiles, that indeed birds are only reptiles which in the course of geological epochs have developed further in a particular direction, probably no doubt can any longer be entertained. The development of the embryos, the structure of the envelopes of the ovum, the peculiarities of the skeleton, which we cannot here enumerate, agree to such an extent, that the uniting of these two classes, at the present day apparently so different, into the single large group of the **Sauropsida** is fully justified. For the sake of those readers who are not initiated into these investigations, I mention here two facts of great importance: all the Sauropsida have only a single articulating surface (in scientific language a single articular condyle) at the back of the head, with the aid of which the head is rotated on the first vertebra, and all the earliest birds have teeth exactly like those of reptiles. Even yet these teeth sometimes appear in embryonic life, as in the parrots and certain other birds, but they never emerge through the gum, and are re-absorbed soon after their appearance.

Position of the Mammalia in the Sub-kingdom Vertebrata.—The **Mammals** accordingly form a third large division, entirely distinct from the other vertebrates. Formerly they were grouped along with the birds as "warm-blooded" animals, because like these they have a uniform and tolerably high temperature of the blood. Over against these two classes were placed the reptiles, amphibians, and fishes with cold blood, or rather with blood the temperature of which depends on that of the surrounding medium. But naturalists have been compelled to recognize the fact that this physiological agreement has only a subordinate value.

But if, on the one hand, the mammals form a separate group, yet, on the other hand, it cannot be gainsaid that in respect of certain characters they present a surprising resemblance to the amphibians. Besides in the structure of the ovum this resemblance is also shown in the fact that all mammals have, like the amphibians, two lateral condyles at the back of the head, and that the movements of the head are altogether different from those which are observed in reptiles and birds. Let us take by way of illustration the movements of the human head. When we raise or depress the head, that is, whenever we move it vertically, we allow the condyles to play upon the corresponding articular surfaces of the first neck vertebra; but when we rotate the head horizontally, then we cause the first neck vertebra to turn round an upright process of the second. The joints for these two sorts of movements are accordingly different. The birds, on the other hand, execute their movements of the head in all directions by means of the single median condyle; they have no second joint of the kind just spoken of.

Mammalian Structure.—Having thus explained the position of the mammals with respect to the other classes of vertebrates, we may now occupy our attention with their peculiar structure of body, which in the most highly developed types of this class has attained the highest grade capable of being reached by the bodily structure of animals.

General Characters.—In almost all mammals the different parts of the body, such as the head, neck, trunk, and its direct continuation the tail, are strictly marked off from each other, and if these demarcations are sometimes not very clearly seen in the living animal, they are nevertheless always plainly recognizable in the skeleton. The neck may be shortened and so concealed by the flesh that the head appears to be directly connected with the trunk, as, for example, in the whales; but in the skeleton one can always distinguish the neck vertebræ, almost invariably seven in number whatever the length of the neck may be. This constancy in the number of the neck vertebræ, a constancy to which a few sloths and the manatee form the sole exceptions, is all the more striking since it is not found to hold good in the case of the other parts of the vertebral column. The tail especially exhibits all possible variations in the vertebræ composing it, both with respect to their number and their form. It may be excessively long, or, as in the anthropoid apes, quite rudimentary.

Only in the mammals is the abdominal cavity, which lies partly between the ribs, separated off by a muscular partition, the diaphragm, from the cavity of the chest containing the lungs and heart.

Special Characters: (a) The Skin and its Modifications.—It must further be mentioned as a specially noteworthy fact, that the two exclusive mammalian characters, the hair and the milk-glands, are both developed from the skin, which, as in all vertebrates, is composed of two distinct layers, the outer or scarf skin, and the inner or true skin.

The scarf-skin or epidermis undergoes the most various modifications. It consists primarily of layers of contiguous cells forming a thin flexible membrane; but it afterwards thickens in certain places, becomes horny and stiff, acquires a further and often very complicated structure, and forms hard callosities, nails, hoofs, horns, and scales. Among these structures belonging to the scarf-skin the hairs, nails, and glands are the most widely diffused.

Hair.—In no mammal is the hair altogether wanting, and though in some, such as the whales, it is only very scanty or apparently not present at all, yet traces of it can always be found either in the young animal or in hidden parts in folds of the skin in the adult. Each hair is formed in a depression of the scarf-skin, and it may assume the most diverse forms. We meet with all transitions from the finest woolly or silky down to large coarse bristles and even spines, which serve as weapons of defence, and appear to consist, like the scales of the scaly ant-eaters, of hairs that have grown together. The horns of the rhinoceros, the horny sheaths of animals with hollow horns, as well as nails and hoofs, appear likewise to consist of agglutinated fibres or small plates, often separated from each other by a considerable amount of pulp.

In most cases the hairy covering of a mammal is made up of two sorts of hair, soft downy hairs, and a stronger kind, which in certain places develops into manes, tufts, beards, and so forth. The depressions or follicles in which the hairs are set are always richly supplied with nerve-endings, which convey impressions of touch. The tactile sensibility conferred thereby is peculiarly well developed in the often very long and thick hairs which form a moustache in many mammals. The general character of the hair-covering, which is in many cases splendidly coloured, forms an important point in zoology.

Equal importance is attached to the nails, claws, and hoofs, in short to all the horny structures, which are almost always present on the toes of mammals, being wanting only in certain types living in the water, such as the whales.

Nails.—The nails, which in the apes and monkeys are flat, and in beasts of prey and many other mammals curved and hook-like, cover only the back of the last phalanx of the toes, while the hoofs envelope it completely. This difference has been employed to distinguish the **hoofed mammals** (*Ungulata*) from the **nailed mammals** (*Unguiculata*); but this division, in consequence of the large number of intermediate forms, has nothing like the value which was at first attributed to it.

Superficial Glands.—Superficial glands, originally formed by an involution of the scarf-skin, are almost universal. They are absent only in some whales. Some of these, the sebaceous glands, secrete an oily slime and are intimately connected with the hair-covering; others, the sweat-glands, appear rather to serve for the excretion of liquids and gases. Those of the first kind may, in certain situations, grow to a very considerable size. This happens mostly in the neighbourhood of the anus and the reproductive organs, but sometimes also on the head, neck, back, feet, and other parts. In general such large glands are connected with the reproductive functions. The products excreted by them are often of a disagreeable penetrating odour, and these glands may therefore serve even as weapons of defence, as in the polecats and skunks. Glands of this nature yield musk, the castoreum of the beaver, and similar products.

Milk-glands.—The most important of the skin-glands finally are those which we call **milk-glands.** They are never absent, but they act only in the female after the birth of the young, and their secretion, milk, which contains all the ingredients necessary for the nourishment of the body, serves to feed the new-born offspring for a longer or shorter period. Like most of the skin-glands they are made up of longer or shorter tubes opening into each other at certain places, and finally opening to the exterior by very delicate canals. It is only in the monotremes that they are seen in their original form, namely, as a bundle of tubes opening separately at a certain part of the abdominal surface without forming any elevation. In all other mammals there are formed mammary glands provided with warty or even tongue-shaped teats or mammæ, which the young animal can take into its mouth in sucking. These teats may be situated at different parts of the abdominal surface—in front of the chest, in the middle of the abdomen, or even far back in the folds of the groin; but they are always arranged symmetrically in pairs, and their number is related to the number of young born at a birth. While these teats in the whales are very short and hidden in folds of the skin, they attain a very considerable length in some marsupials, among which animals they either lie in a well-formed pouch or at least between two folds of the skin. In the teats are united the secretory ducts of a number of gland-tubes, and there they form a sort of reservoirs opening to the exterior by one or several mouths.

(b) **The Skeleton.**—We should exceed the limits assigned to our work if we were to go into the details of the structure of the bony skeleton which holds the parts of the body together. We can only touch on certain points which cannot be passed over in a zoological review of the group.

The Skull.—The skull forms, with the exception of the lower jaw, a single piece composed of bones immovably fastened together. Two separate parts can be distinguished, the brain-case and the facial region, the latter including the nose, the eyes in part, and the commencement of the alimentary canal, the mouth. To this firmly built skull with immovable parts is articulated the lower jaw, which is composed of two halves united at the chin, and sometimes, as in the apes and monkeys, completely fused together, sometimes separated by a distinct suture, or connected only by ligaments. The immovable attachment of the bones of the upper jaw and other bones of the skull to each other and to the brain-case is not found in most other vertebrates, in which it is rather the rule for the bones of the facial region to be separate and movable. The upper jaw always consists of two bones on each side; the inter- or pre-maxillary bones in the middle of the mouth, and the maxillæ forming the sides. But these are not movable on each other, but are connected by sutures, and often become quite fused together at a more or less advanced age. In all vertebrates, except the mammals, the lower jaw is composed of several bones connected by sutures. Only in this class does each half of the lower jaw consist of but one bone.

We shall have occasion later on to speak of the teeth, which are found only in the bones of the jaws, and form in the upper as in the under jaw only a single row,[1] while in most other vertebrates the teeth may be set in all the bones which go to form the cavity of the mouth.

The relations between the brain-case and the facial region of the skull vary considerably. The former part is more fully developed the higher the development of the brain, and with it the mental qualities of the animal. The low types, such as the marsupials, have very tiny brains and insignificant brain-cases in comparison with their powerful jaws. But many subsidiary structures may conceal these marked contrasts, especially in the living animal. The cavities known as the frontal sinuses, which are continuations of the cavity of the nose, and are found between the two plates of the frontal bone, may be developed to such an extent that they take up, as in the elephant, considerably greater space than the brain itself. Longitudinal and transverse ridges, which are required for the attachment of the powerful muscles of mastication, may likewise impart to the brain-case a more imposing appearance than it would otherwise have. The length of the jaws, which stands in relation to the action of these parts as levers, may undergo considerable variations in accordance with the greater or less degree of savageness in the instincts of the animal. Yet in spite of these special circumstances affecting the external appearance of the brain-case, it may confidently be asserted that animals have a larger or smaller brain according as they are distinguished by high or low mental endowments, and that the brain-case formed more or less strictly in accordance with the size and shape of the brain enables us to judge approximately of the development of the organ inclosed within it.

The Limbs.—We do not intend now to consider in detail the structure of the vertebral column, the ribs and breast-bone, but we must make a closer examination of the limbs, the structure of which has often afforded the fundamental distinctions for the subdivision of the mammals.

All mammals have originally had paired fore- and hind-limbs, more or less closely connected with the skeleton, in front by means of the bones of the breast and the shoulder-girdle, behind by means of the pelvis. The fore-limbs persist in all members of the class, but the hind ones have disappeared in the whales and sea-cows (Sirenia). But this is only the result of a process of degeneration, and small bones, which are nothing else than the rudiments of these undeveloped limbs, can still be found hidden in the flesh of these animals.

---

[1] There is only one partial exception to this statement, namely, in the sub-division of the rodents known as the Duplicidentata (including the hare and rabbit), in which, as stated in the proper place in the body of the book, there are two small incisors behind the two large incisors in the upper jaw.—Tr.

The Shoulder-girdle.—What is known as the shoulder-girdle is composed originally of three bones, the shoulder-blade or scapula, the collar-bone, and the coracoid. These bones are still found separate in the monotremes as in the lower five-fingered vertebrates. But in all other mammals the coracoid early becomes fused with the shoulder-blade, of which it then forms a process. The collar-bone is very variable in its development. It might be called the bone of the specialized function of the limb, the bone which enables the limb to act in some particular way. It is, in fact, present in all mammals in which the fore-limb has to perform complicated functions, in which, for example, it is employed as a hand for grasping, as a spade for digging, or as a paddle in swimming; but it becomes rudimentary or vanishes entirely when the limb has merely to support the body in walking and running.

The Fore- and Hind-limbs.—The fore- and hind-limbs correspond with each other as regards the composition of their bony framework. The bone of the upper arm (the humerus) corresponds to the thigh-bone or femur, the radius to the tibia, the ulna to the fibula, the wrist to the ankle, the metacarpus (the bones of the palm of the hand) to the metatarsus (those of the sole of the foot), the fingers finally to the toes; and in spite of the fact that the elbow and the knee have contrary directions these joints are also homologous.

Now nothing is subject to greater variations than the structure of the limbs, which are primarily affected by adaptation to the most diverse modes of life. Is it possible, indeed, to imagine organs more different than the foot of a horse, the paw of a dog, the hand of an ape, the fin of a dolphin, and the wing of a bat? And yet these limbs, so diverse in respect of their structure and function, are all constructed on one and the same ground-plan; they are composed of the same elements, and the final result has been brought about only by modifications and processes of reduction and suppression originally not at all striking, but which have gone on gradually accumulating.

In order to understand these transformations we must go back to the primitive conditions which are to be seen, on the one hand, in embryos, and, on the other hand, in the oldest ancestral forms known to us. What do we then see?

The limbs of the embryo scarcely differ at all from one another. In the embryo the fore-limb of a bat, which is destined in the adult to support a flying membrane, is exactly like the hind-limb, which ultimately develops into a sort of paw with five toes and curved claws. The limb of a kangaroo does not, in the first instance, differ in any way from that of a monkey or a sheep. The initial form is always the same: a small lobe attached to the side of the body, and having developed on it five rays, the future toes, which are connected together down to their extremities by a membranous continuation of the lobe. One of these rays, which corresponds to the thumb or first digit (for we always count the digits beginning with the thumb or great toe) stands a little apart from the other four, each of which has its axis corresponding to that of the limb itself.

The original form of the mammalian limb is accordingly in all cases that of a flipper, the thumb of which stands a little apart, while the digits are all connected together by the skin.

From these facts we deduce the conclusion that the webbed feet of the beavers, otters, seals, in short of all mammals living in the water have preserved the original type, which has become specialized in a particular direction, or, in simpler language, has become adapted to a special use, in the fin of the whales and sea-cows.

If we trace the development of the flying-membrane step by step in the embryo of the bat, we can easily be convinced that this member is only an aerial paddle, the structure of which has remained essentially the same as that of the aquatic paddle of the seal. In the flying-membrane of the bat the chief part of the supporting framework consists of the greatly elongated bones of the fingers or digits, but the motion of the membrane in the act of flying is effected by means of the rest of the fore-limb just as in the flipper of the seal, in which the same bones are present, only not elongated and not spread out. Apart from the elongation of the digits and the extension of the membrane necessitated by the gaseous element in which the creature has to "swim," the wing of the bat is thus exactly like the flipper of the seal. It is accordingly only a swimming-paddle specially developed with respect to the surrounding medium, and one that has undergone no other modifications than those affecting the dimensions of the parts.

In the other terminal members of mammals the connecting skin extends no further than the roots of the fingers or toes; but remains of this connecting skin are still found in almost all mammals.

Then a second fact is likewise conspicuous. The first digit, the thumb or great toe, takes from the very first a different direction from the other digits. This divergence is maintained in most mammals, and in addition to that the fact that this digit has only two instead of three small bones or phalanges contributes to give to it a peculiar position. From a thumb having this difference in direction as compared with the other digits to a true thumb capable of being opposed to the other digits, as in the human hand, there is no very great interval, and we have moreover numerous examples of intermediate forms. Besides, all limbs with opposable thumbs or great toes have five digits, and have accordingly preserved the original number.

The Hand.—From these facts we infer that the limbs with the first digit standing apart from the others represent the original form, and that those with an opposable first digit, in one word, hands, are a very old type. We find, in fact, hands on the hind-limbs in opossums and phalangers, lemurs and monkeys; and in the two latter groups we have in addition hands on the fore-limbs, which are the only ones that persist in man. Although the hand is indeed a wonderful instrument, it is nevertheless a very old pattern. How could the marsupials just named, which are among the lowest mammalian types, possess hands if these members represented the last and highest stage of development of the limbs?

If then a five-toed foot with the first toe standing apart from the others is the primitive form, one that we meet with in the oldest mammals known to us, all the other forms of limb, often very much modified, must necessarily have originated in this fundamental type.

This modification has been brought about mainly by the degeneration of separate parts beginning with the digits and proceeding upwards, but is also due in some degree to the excessive development of other parts. For details regarding this matter we refer the reader to what is said with reference to the separate orders. One will be able to judge of the enormous influence which has been exercised by the processes of reduction and fusion (the entire loss of certain bones, and the merging of two or more into one) by comparing two extremes, for example, the fore-foot of a porcupine ant-eater (Echidna) and that of a horse. The former is five-toed and has the full number of bones, namely thirty-three; the latter is single-toed, has fused and degraded bones, and the total number of the bones is only seventeen, and two of these (two bones belonging to the metacarpus) are functionless.

The process of reduction can in this case be traced both in the embryo and in ancestral forms, which lay buried in past geological strata; and from all these facts we may draw the general conclusion, that all mammals with reduced or degraded digits must be descended from ancestors with complete five-toed feet, and that these modified feet are the result of a longer or shorter series of successive variations.

The Position of the Limbs in Walking: Digitigrada and Plantigrada.—One last point still remains to be explained. The limbs carry the body, but they carry it in various ways. The ruminants as well as the horses, the cat tribe as well as dogs and their allies, place only the points of their toes on the ground; they are **Digitigrada.** The apes and monkeys, the Prosimii (lemurs, &c.), bears, most of the marsupials and the monotremes touch the ground with the entire sole, including even the wrist and ankle; they are **Plantigrada.** In certain orders we can follow the process of raising the sole above the ground step by step, so that the designations Semi-plantigrada and Semi-digitigrada have been adopted for certain stages in this process, although no great value can be assigned to these sub-divisions. Yet the fact itself does not thereby lose its importance, for all the old Eocene mammals are plantigrade, whether Carnivora or Ungulata, Perissodactyla or Artiodactyla, Insectivora or Rodentia. From this we conclude that all the Digitigrada have had plantigrade ancestors, and that the plantigrade mode of progression, such as is found in man himself, must be regarded as a primitive character which has been retained.

The Teeth.—One of the most complicated chapters in the natural history of the Mammalia is that which relates to the **teeth,** and we readily concede that it presents difficulties that might deter more than one reader who did not wish to make any special study of the subject. Although we are far from wishing to disguise these difficulties, yet we must take the subject resolutely in hand, for not only does the division of the Mammalia into subordinate groups depend in a great measure on the dental system, but this system also possesses the great value of being the essentially conservative element of the whole skeleton. If all the variations in the surroundings, in the nature of the food, and the mode of life are reflected in the structure of the teeth, there is, in fact, no other part of the skeleton accessible to the palæontologist which preserves the essential characters of a type with such certainty, and in this way enables him to recognize the points of resemblance and affinity that may obtain among the different forms. In any case the study of the dental system forms the foundation of a knowledge of the Mammalia generally.

Only an infinitesimally small number of mammals are actually without teeth. The porcupine ant-eaters, the ant-bears, the scaly ant-eaters, and the whalebone whales belong to the number. Yet teeth have been found in great numbers in the jaws of embryo whales, but these teeth are completely embedded in the gum, which they never cut, and are afterwards re-absorbed when the whalebone has formed in the mouth. It is likewise highly probable that traces of teeth will yet be found in the jaws of the embryos of the terrestrial mammals mentioned. Analogy seems to prove that the absence of teeth in mammals is always the result of a process of reduction carried to the last extreme.

Structure of the Teeth.—The teeth of mammals are formed in closed sacs or depressions in the jaw, and do not cut the gum till they have reached an advanced stage of development. The proper nucleus of a tooth is composed of the so-called *dentine.* This peculiar bony substance is characterized by the presence of numerous branching canals (tubuli) which run from the inner cavity of the tooth (the pulp cavity) towards the surface. Whatever the subsequent form of the tooth may be, this dentine is always originally deposited as a sort of cap round a fleshy protuberance rich in vessels and nerves, and the hollow of this cap is filled with dentine.

On the latter there rests in most cases a second cap composed of very hard columns set close together, and forming what we call the *enamel.* This shining brittle substance usually covers only what is called the *crown* of the tooth, that is, the part that rises above the gum. For the most part the crown is protected on all sides by this covering; but in many cases, as, for example, in the incisors of rodents, we find it mainly on the front of the crown, and only a very thin plate behind. The enamel thus extends in general as far as the gum, and thus serves to distinguish the crown from the root, which is set in the gum. Besides these two chief substances, there are frequently also other tissues entering into the composition of a tooth—true bone-tissue at the root and cement on the crown, this last substance being peculiarly abundantly developed in compound teeth, in which it fills up the folds and other depressions.

In the structure of the roots or fangs considerable diversities appear, in consequence of which we have teeth that keep constantly growing and others with a limited period of growth. Consider, for instance, the incisor of a rodent. The pulp cavity opens out wide at the lower end, where the dentine gradually thins away, while the pulp nourishing the tooth fills up the whole cavity. Teeth so formed keep on growing through life, and this constant growth is counteracted only by the fact that the crown gets constantly worn away by use. The tusks of the elephant and those of the wild boar are both of this nature. In a number of other teeth, however, the pulp cavity gets gradually narrower towards the bottom, where it forms at last only a minute opening. This condition is brought about in the course of the development of the tooth, for at first the root is always wide open, and after this constriction of the pulp has taken place the tooth ceases to grow, since the vessels that ascend through it are only sufficient for the nourishment of the tooth. Most of the teeth of mammals have this structure. They may be replaced by a later set pushing out the earlier ones; but once formed they undergo no further change in the way of growth.

Teeth with several fangs are found only in mammals. A tooth with a double or treble fang belongs unquestionably to a mammal; and, indeed, most molars and premolars have compound fangs, while incisors and canines, with very few exceptions, have only single roots.

From our description it will be seen that the more or less conical teeth with open roots, such as we find, for example, in the dolphins, represent the original form, a form which is also found in the reptiles and amphibians. The closing of the root and the cessation of growth mark a higher stage of development, which leads to a phenomenon occurring only in the Mammalia, namely, the appearance of two sets of teeth in succession—the milk and the permanent teeth.

Milk and Permanent Teeth: Monophyodonts and Diphyodonts.—The jaws of embryos and young animals are relatively very short; but afterwards they often become immoderately long. The consequence of this elongation is that the first teeth, which sometimes appear before, but mostly not till after, birth, cannot occupy the jaws throughout their whole extent. A second set of teeth is accordingly developed, altogether independently of the first, and through the appearance of this second set the number of the back teeth is in general increased, while those in front are more or less completely replaced by new and better arranged teeth. Whatever be the mode in which this exchange is effected, and whatever processes nature may resort to in attaining this end, we must before all things keep in view the very considerable alterations that are thereby brought about.

First, it is manifest that this exchange is necessary only where the teeth have a limited period of growth. The teeth which keep constantly growing have no need to be renewed, though their number or their size may have to be increased in proportion to the growth of the jaws. The Cetacea and the Edentata, in which no exchange whatever takes place, have been distinguished as **Monophyodonts,** the others, which have two sets of teeth in succession, as **Diphyodonts.**

Yet here also there are essential differences. The last stage of development, which is attained by the apes and monkeys and the carnivores, is very simple. All the front teeth, incisors, canines, and premolars, which form the milk dentition of a child of about seven years old, are deciduous, and are replaced one by one by new teeth, while a few molars are added in the back part of the jaws. In such cases the distinction between the milk and the permanent dentition will always be pretty easy. More frequently, however, these relations are very far from being so simple.

Certain teeth, both of the first and second set, develop indeed to a certain stage, but never cut the gum. They remain entirely embedded in the gum and are afterwards absorbed. Others drop out shortly after they have appeared, and if they belong to the milk dentition are not replaced by permanent teeth. Finally, the number of the teeth which are exchanged is also very variable. Thus in the marsupials only a single tooth, the last premolar, is shed, while all the others remain in their original places. The order in which the teeth are replaced is just as variable as the time at which this phenomenon occurs. Some bats, for instance, lose their first teeth while still in the womb of the mother. In many cases, moreover, the first set of teeth is very different from the second, and, indeed, often has a considerably different character. The aye-aye is an insectivore in its milk dentition, but in its permanent dentition a rodent. And if the entire dentition does not often alter its character, this is frequently the case with at least a certain number of the teeth. The carnassial tooth of the Carnivora alters its place. It travels, so to speak, towards the back of the mouth in the permanent dentition.

The general fact remains, however, that a certain number of back teeth are never shed, and only appear once for all, namely, at the time when the shedding of the other teeth is in progress or nearly completed. These teeth commonly have a more complicated form than the others. They are those which are called true molars.

But let us return to the teeth themselves, and consider first their form and structure. If the form of a simple cone, a cylinder, or a column is the primitive one, the form which is still retained most frequently in the front teeth, it cannot be asserted nevertheless that it is the form universally retained. It may be materially modified by the presence of notches and folds, clothed with enamel, and situated either on the grinding surface or on the sides of the crown. If such folds are found on the grinding surface, then there arise grooves and depressions, between which higher parts remain standing in the form of tubercles, ridges, and peaks. All these structures may be reduced to three leading types. In one the tubercles get worn down to a level surface and remain low; they are broad and rounded, the crown likewise becomes flat and more or less quadrangular. This is the type of the omnivorous tooth, such as we find in pigs, bears, and others. Secondly, the tubercles may be pointed and get worn away on the lateral surfaces by friction against the teeth in the opposite jaw. In this manner are formed the teeth with pointed cusps of the insect-eaters. Thirdly, the tubercles may be elongated in the direction of the jaw into sharp lobes, which act like shears against the corresponding lobes of the opposite teeth. Of this type the teeth of the carnivores offer striking examples.

The lateral folds of the crown, which in the first instance are mere vertical flutings, may become more pronounced, and may be found on one side only or on both at once. We then get teeth which, like those of the rodents, exhibit folds or grooves on the worn surfaces. These folds gradually become in different animals more sinuous and deeper, till at last they meet in the interior, and give the teeth the appearance of being composed of two halves, or of two columns set together on the grinding surface of the tooth like half-moonshaped islets, and making it appear as if the teeth had been subjected to a certain amount of pressure. All these different and variable forms are nevertheless deducible in the end from a crown with sharp or blunted tubercles; and the oldest placental mammals exhibit such types with varying characters, types which we now designate as insectivorous or omnivorous teeth, and which may develop further in the one direction or the other. Palæontologists have made the observation that the folds of the teeth are originally remarkably simple, but always become gradually more complicated in their descendants. The series of teeth observed in the development of horses and ruminants afford excellent examples of this increasing complicacy.

The forms with deep folds dividing up the teeth may be combined with others which appear to have arisen from the fusion of several small teeth. The molars of the elephants present the most complete example of this type, in which tooth-fragments are agglutinated together by cement into a single large tooth. On the other hand, it would be possible to maintain, if we traced the series of teeth from the mastodons downwards through the extinct elephants, that these tooth-fragments, each of which has a separate root, have arisen from a continued process of division.

But, however that may be, the structure of the teeth and the arrangement of the different kinds afford the surest marks for distinguishing affinities between the different mammalian types.

Usually the teeth are divided in accordance with their position in the jaws, but with reference also to their forms and the relations brought to light when the milk-teeth give place to the permanent set. We will now give the explanation of the terms made use of in describing the dentition.

The upper teeth are set in two pairs of bones, the premaxillæ in front and the maxillæ behind. All the teeth set in the premaxillæ, whatever be their form, are called **incisors.** The tusk of the elephant, as well as the curved, sharp-edged, chisel-shaped tooth of the rodent, the pyramidal tooth of the musquash or North American musk-rat (*Fiber zibethinus*), and the recurved hook-like tooth of the shrews, are all incisors, for they are set in the premaxilla, the separation of which from the maxilla remains almost always visible in the mammals. In the lower jaw, which is composed of a single bone on each side, the mandible, there is not the same valuable criterion for distinguishing the incisors as in the upper jaw; and in it all those front teeth which present a greater or less resemblance to the incisors of the upper jaw are generally distinguished by the same name.

After the incisors there often comes a recurved tooth which in most cases rises above the level of the others. This, which is especially characteristic of the carnivores, has been called the **canine.** But it is found also in omnivorous animals and even in certain herbivorous ones, for instance, in the musk-deer, and is especially large and powerful in the male, in which it is a weapon not to be despised. In the rodents, in most of the ruminants, and in fact in many mammals, it is wanting altogether, or is found only in the upper jaw.

Behind the canine is developed the series of **molars,** which are divided into **premolars** and **true molars.** The only means which we have for distinguishing these two groups from each other is that afforded by the exchange of teeth. The term premolars is applied to all those which are shed and get replaced by others, while those which belong solely to the permanent dentition are designated **true molars.** But in practice it is often difficult to carry out the distinction from this point of view, since the milk dentition is not always known. In that case the first four of the row of teeth situated immediately behind the canines are commonly known as premolars, being mostly distinguished from the succeeding ones by their simpler form.

In order to express the distinctions presented by these teeth naturalists have devised certain formulæ, of which we have made use in this work also, and which we must therefore explain. Different authors have naturally adopted different formulæ, but we have employed those which appear to us the simplest.

Dental Formulæ.—The teeth are always arranged symmetrically; on the right side there is always the same number of teeth as on the left. It is consequently sufficient to give those on a single side. On the other hand, the number of the teeth in the upper jaw is often considerably different from that in the lower. Accordingly two rows of figures are adopted for the two jaws, and the numbers are arranged in accordance with the terms explained above. Suppose, then, the reader meet with the following formula:— $\frac{4 \cdot 1 \cdot 4 \cdot 3}{3 \cdot 0 \cdot 3 \cdot 4} = 44$; how would he have to understand it? The row above the line gives the teeth standing in one half of the upper jaw; and the animal thus has in each half of that jaw four incisors, one canine, four premolars, and three molars, in all twelve teeth, or twenty-four in the whole jaw. In the lower jaw, on the other hand, there are only three incisors, no canine, three premolars, but four molars, accordingly ten in all in each half of the jaw, or twenty in the whole jaw. For this animal consequently the total number of teeth amounts to forty-four, and since all the sorts of teeth are here represented the dentition is called a **complete** one. If the premolars and molars cannot be distinguished they are included in a single figure, as thus:— $\frac{1 \cdot 0 \cdot 4}{1 \cdot 0 \cdot 4} = 20$. This is the formula of a rodent, and intimates that the animal has one incisor above and below in each half of the jaw, and four molars which cannot be more particularly discriminated, and that in both jaws the canine is wanting.

But the dentition may be altered not merely by the substitution of a permanent for a milk set, but also by another process, namely by the premature disappearance of certain teeth in the course of years. At bottom this phenomenon is only a continuation, or the carrying out to a further stage of that already mentioned, the non-development of teeth the rudiments of which appear in the gum. This premature disappearance is a very frequent occurrence, and is observed especially in the more recent mammals when compared with their immediate predecessors, which retained throughout life certain teeth which their descendants lose after a short period.

Evolution.—These facts lead us into a higher region, that of the gradual perfecting of the dental systems during the evolution of the ancestors of the present mammals carried on through past geological epochs. Now what is this process of evolution, and by what facts is it recognized?

The answer to this question is not by any means easy to give. So far we know only a few large general features of the picture which it will remain for the future to complete. For the present we will only briefly summarize a few of the most important facts.

We are not acquainted with any mammals belonging to a very early period with simple conical teeth altogether unspecialized. We know, however, some mammals now living, and among these are included the dolphins and the giant armadillo, which possess such teeth in almost unlimited number—it may be a hundred or more. Now these teeth, like those of the lower vertebrates, are all similar, and are set so far apart from each other that, when the mouth is closed, the teeth of the one jaw fit into the gaps left between those of the other.

As soon as the teeth begin to exhibit a more specialized form, their number becomes limited. Yet in the older mammals this number is still considerable, and some of the marsupials now living have retained this character, the possession of a large number of teeth. We have only a few lower jaws of marsupials belonging to Triassic and Jurassic times, and these are equipped with an unusually large number of teeth. Dromatherium from the Trias has fourteen, Amphitherium from the Stonesfield Slates (Oolitic series of the Jurassic strata) sixteen, Phascolotherium, from the same slates, eleven teeth in a single half of the lower jaw. Now, if we assume that the same number was present in the upper jaw, then we get totals of 56, 64, and 44 teeth. The fauna of the present day includes the banded ant-eater (Myrmecobius) with 54, the opossums with 50, the bandicoots (Peramelida) with 48, the Tasmanian wolf (Thylacinus) and the genus Phascogale with 46 teeth. The Monodelphia of the Tertiary period have all 44 teeth, and among the Monodelphia of the present day there is only a single genus, Otocyon, belonging to the Carnivora, in which this number is exceeded. In it there are 46 teeth.

But all these teeth are specialized. Fully developed incisors, canines, premolars, and molars can be distinguished even in the oldest mammal of the Trias, the Dromatherium, and if the front teeth stand more or less apart, the back ones begin to press more and more closely on one another, and show the characteristic double fangs. We can trace these combined modifications in following out the evolution of a particular series. As the dentition becomes transformed from the general omnivorous or insectivorous type to one of a more special character we see the teeth reduced in number, and at the same time more and more individualized with respect to form and complexity of structure. Here, accordingly, we meet with a course of development analogous to that observed in the limbs: reduction of the number of the constituent parts, and specialization of the functions belonging to these parts. With reference to this we must not forget that the oldest mammalian dentitions known to us possess all sorts of teeth in exceptionally great number and with closed roots, and that accordingly every incomplete dentition must be the result of a process of development, and that development frequently retrograde, or from a higher to a lower type.

Reproduction.—We may pass over the other features in the structure of the mammals in order to dwell at somewhat greater length on the peculiarities pertaining to their reproduction. And here what we have to concern ourselves with is not the number of young ones produced, which varies remarkably according as the struggle for existence is more or less easy for an animal, but the phenomena on which certain subdivisions of the Mammalia have been founded.

All mammals bring forth the young alive, and the young are suckled by the mother for a certain period after birth. Yet there are considerable differences in the relations subsisting between mother and young before birth.

In some, which are called **Didelphia** or **aplacental mammals,** there is no intimate connection between the ovum and the maternal organs in which the earliest development of the embryo is accomplished. The envelopes of the embryo, the **amnion,** and the **allantois,** are indeed formed, but the latter membrane does not enter into connection with the walls of the uterus. The ovum remains entirely free, and the embryo is ushered into the world in a comparatively backward stage of development, although, indeed, provided with all the essential organs. The monotremes and marsupials, which are thus reproduced without a placenta, exhibit at the same time all the marks of a strikingly low position in the scale of being. Their brain is scarcely more highly developed than that of reptiles, and as regards the structure of the axial skeleton, as well as that of the teeth and limbs, we have already seen that it agrees in many points with that of the oldest mammals.

Much more intimate is the connection which subsists between the fruit of the body and the mother in the great majority of mammals, which are called **Monodelphia** or **placental mammals.** In them the blood-vessels of the embryo, which are brought through the allantois to the surface of the ovum, form in combination with those of the uterus a special organ known as the **placenta.** The vessels belonging respectively to the allantois and the uterus do not run into one another, or, in technical language, anastomose, but return in loops on each side, and the gaseous and liquid substances contained in the blood that circulates in them are exchanged solely by the process of osmosis, that is, by filtering through the walls of adjoining vessels. The embryo has its blood purified, and is fed by means of the placenta. The blood of the mother conveys to it the requisite supply of oxygen and the other substances necessary for its life and growth, and at the same time removes the carbonic acid and other refuse products of its vital action. The formation of the placenta is thus a fact of the highest importance, and one can easily understand why the first place has been assigned to it among the characters on which a natural division of the Mammalia is based.

May this also be the case now with respect to the **form** of the placenta? I take the liberty of doubting this, in spite of the authorities who lend their support to the maintenance of this view. When a division, based on the form of the placenta, was first proposed I gave in my adhesion to it, but now I believe, in view of more recent discoveries and in consequence of certain more profound investigations, that we are entitled to assign to the form of the placenta only the value of a subordinate character.

We can indeed trace the development of the placenta step by step in our mammalian forms. The ovum is from the first surrounded by an external membrane, the **chorion,** and this gradually becomes covered with cellular processes called **villi,** into which the embryonic vessels penetrate. These villi get inserted into simple pits or depressions in the mucous membrane of the **uterus,** known as **crypts,** from which they can easily be detached. Therewith begins the formation of the placenta proper, and in many animals the relations between the mother and the fruit of the womb are confined to these simple vascular villi. But the latter become more complicated; they give off branches, penetrate further into the mucous membrane, get aggregated into certain spots, which, however, are distributed over the whole surface of the ovum, and in that way form so-called **cotyledons,** each of which consists essentially of a bundle of vessels; and though all of them become detached at birth from the mucous membrane, this happens with greater difficulty than in the former case. These forms, with the numerous intermediate varieties, have all been comprehended under the general designation of **indeciduate placentas.** In other cases the cotyledons are all congregated together at certain parts, become intimately united with the maternal organs into a single organ, and at birth at least a portion of the mucous membrane of the uterus, the so-called **decidua,** always becomes detached and extruded. Mammals with such a form of placenta have been called **Deciduata,** and among these, two chief forms have been distinguished, one in which the placenta is shaped like a belt surrounding the ovum, the so-called **zonary placenta,** and one in which it has the form of a cake, the **discoidal placenta.** But these structures represent only higher stages of development, and in many cases approach one another so nearly that, for example, investigators are not yet agreed whether to ascribe to the Prosimii a bell-shaped deciduate placenta, or simple chorionic villi congregated together at one pole of the ovum.

The division of the mammalian orders according to this principle would be somewhat as follows:—

(1.) **Indeciduata.** (*a*) With simple chorionic villi (diffuse placenta). Cetacea, Sirenia, Perissodactyla, Pigs, Hippopotamuses, part of the Ruminants (Camels and the genus Tragulus), Scaly Ant-eaters (Manis), Prosimii; (*b*) With branched chorionic villi (scattered cotyledons); the rest of the Ruminants. (2.) **Deciduata.** (*a*) With zonary placenta: Carnivora, Pinnipedia (Seals), Proboscidea, Hyrax; (*b*) With discoidal placenta: Rodentia, Insectivora, Chiroptera, Simiæ, Edentata (with the exception of the scaly ant-eaters).

In whatever way we look at this arrangement it must always be acknowledged that it involves absurdities. It is impossible to deprive the hyrax and the elephant of their affinities to the other Ungulata, in order to rank them with the Carnivora, or to place the scaly ant-eaters at the one end of the series, while the common ant-eaters are found at the other; and the group of the Artiodactyla, or even-toed ungulates, shows us that one type may have retained the primitive structure of the placenta, while another very closly allied type (that of the Perissodactyla, or odd-toed ungulates) has attained to a much higher degree of perfection in this organ.

Distribution in Space.—In treating of the individual orders of the Mammalia we have always added a concise survey of their **geographical distribution,** and have sought to combine the results arrived at with the probable presumptions as to the **evolution** of the stock. We therefore explain in this general introduction the points of view from which we have regarded this part of the subject.

Formerly it was attempted to explain the undeniable discrepancies in the distribution of animals over the earth by the assumption that they were ascribable to the surrounding conditions, and especially the climate, the supplies of food, and in short all those influences which can make themselves felt in particular regions. This supposition undoubtedly rested on actual facts. The influences which the surrounding media have exerted on the struggle for existence cannot be denied. If the animals belonging to northern regions and lofty snow-clad mountains were seen to become white in winter, there was in that single fact manifest proof of the adaptation of the organism to external conditions.

But such facts were far from exhausting the problem. There remained too many doubts as to a number of circumstances, particularly in view of what had been effected on this field by man. The horses, cattle, and sheep introduced by him into America and Australia succeed there much better, or at least quite as well as at home. Moreover, these animals revert there to the wild condition, and are not only adapted by their own powers for the struggle for existence, but are even victorious in that struggle over the native animals. How then does it happen that such extraordinarily favourable conditions of life have not brought into existence these animals there as in other lands? South America is just as rich in monkeys as the forests of India and Africa. How then does it happen that the apes and monkeys on both sides of the ocean are so different from one another? And if monkeys can live in all hot regions of both hemispheres, why do we not find antelopes, elephants, rhinoceroses, cattle, and insectivores, as well upon the one as upon the other?

I could multiply these examples endlessly, but they would all confirm the insufficiency of the alleged grounds for the discrepancies in distribution.

The Darwinian theory of the origin of species could not but introduce other points of view. Since our animals of the present day are direct more or less modified descendants of the extinct ones, the geographical distribution of the present day can manifestly be only the consequence of that of the primitive stocks. These have formed, if I may so express myself, the raw material which all the various influences that can bring about more or less well-defined variations, have worked up within the limits assigned by the distribution of land and water.

The present geographical distribution of mammals is thus intimately related to their origin. Land mammals descended from ancestors which were restricted to a continent, forming an island surrounded by the waters of the ocean, have not been able to develop on another continent inaccessible to them, however favourable the conditions of life there might be. Broad rivers, high mountain chains, deserts, and marshes could not but hinder the advance of certain types, and have actually prevented their introduction into regions which were cut off by barriers of that nature.

Every species, however strong or weak its powers of reproduction and organs of motion may be, would actually be distributed over the whole earth through its multiplication in geometrical progression and its consequent migrations, if it were not confined by such barriers, and had not its ranks thinned by enemies and by the absence of the conditions of existence. The various causes have acted in former times just as they are acting at the present day, and their combined effects and mutual action and reaction are expressed in the present geographical distribution of animals.

In his admirable work on the Geographical Distribution of Animals Wallace adopts six great regions[1] in which the animals are grouped in a special manner. Three of these belong to the Old World, two to America, and one to Australia. Each of these regions has besides a certain number of sub-regions. The great **Palæarctic region** comprises the whole of the Eurasian continent, except the south-east, together with the islands of Japan, Iceland, Great Britain, the Azores, the Canary Islands, and the islands of the Mediterranean. It comprises the whole of Europe, Africa as far as the Sahara and the Cataracts of the Nile, also Asia Minor, Arabia, and the entire continent of Asia as far as the large mountain chains of the Himalayas —an enormous region, in which Wallace endeavours to distinguish a European, a Mediterranean, a Siberian, and a Manchoorian sub-region. The great **Æthiopian region** comprises the African continent south of the Sahara, and in addition to that, as a sub-region, the island of Madagascar. The great **Oriental region** embraces Asia to the south of the Himalayas, together with the Sunda Islands and the Philippines. The **Australian region** is not restricted by Wallace to the large island of Australia with Tasmania, but extends also over all the islands from Celebes to the Sandwich group. South America, with Mexico, Guatemala, and the Antilles, form the **Neotropical region,** and the rest of North America finally constitutes the sixth, the **Nearctic region.**

Of these regions, as of all others that have been adopted, it may be said that none of them is limited by precise boundaries, even if we leave out of account the more or less cosmopolitan animals, and devote our attention only to forms confined within narrow limits. If we would represent these regions on maps, we must surround each of them with a pretty extensive zone in which the forms have intermingled or passed from one region into the other. Besides there are in this scheme areas which have been ranked as sub-regions, and which yet deserve a separate independent position, at least in respect of their mammalian forms.

Thus we must undoubtedly adopt a **Circumpolar region,** embracing the north of Siberia, Lapland, Greenland, the Hudson's Bay Territories, and all the islands adjacent to these portions of the mainland. In all parts of this region are found the same, or at any rate very closely allied, species: to it belongs the territory of the polar bear, the reindeer, the glutton, the lemming, and other characteristic forms. The island of **Madagascar** is totally different from the mainland of Africa in respect of its mammalian fauna, and, in general, is one of the best characterized regions. The **Antilles** also have scarcely anything in common with the neighbouring mainland. If these three regions are separated off as of equal value with the great leading regions above named, we then have nine regions marked off for the geographical distribution of mammals, and each of these is distinguished by a separate assemblage of animals, by its own peculiar fauna.

In order to understand the partly strange partly uncertain boundaries of these regions we must have recourse to the indications furnished, on the one hand, by geology as to the relations between land and water in earlier epochs, and, on the other hand, by palæontology concerning the existence and distribution of mammals which lived in those epochs. In many cases these indications are still very incomplete, in others more or less uncertain. In such cases we must be content to recognize the fact of these gaps and uncertainties, while utilizing in our investigations the assured results that have hitherto been obtained.

---

[1] They are adopted with certain modifications from a division of the earth originally proposed by Mr. P. L. Sclater for birds.—Tr.

We will speak in the first instance only of land mammals. And here we are at the outset struck by the fact that those boundaries, on the one hand, separate territories that are manifestly continuous at the present day, and, on the other hand, unite others now distinctly separate; and that finally among these last cases we meet with examples in which the mammalian distribution in different regions is strikingly diverse in spite of the apparent correspondence in geographical relations. Such examples are easy to find.

The channel between the island of Trinidad, the most southerly of the Antilles, and the mainland, at the mouth of the Orinoco, has almost the same breadth as that which separates the British Isles from the European continent. But what a difference is revealed in the mutual relations! The mammalian fauna of England is in no respect different from that of Brittany, while in the case of Brazil and the Antilles almost everything is different. In Brazil monkeys, carnivores, and edentates are uncommonly well represented, and of these groups the Antilles show no trace. Brazil, on the other hand, does not support a single insectivore, while the Solenodons are confined to the Antilles. Only a few rodents, bats, and peccaries are common to Brazil and the archipelago named. These differences are explained when we learn from geology that at a recent epoch England was continuous with the mainland, that the animals of the Quaternary period, the immediate ancestors of our present mammals, walked dry-footed across the English Channel, while the interval of sea which presents such an insurmountable barrier between Trinidad and Brazil is in process of being filled up by the alluvial deposits of the Orinoco, and formerly was much broader. We might think it strange also that the whole circumference of the Mediterranean is regarded as a continuous subregion, while the main body of the continent of Africa, apparently directly connected with it, is completely separated by the Atlas Mountains; but for this also geological investigations have furnished the explanation. The Strait of Gibraltar is due to an irruption of the sea of comparatively recent date; more than one isthmus ran from the northern shores of the Mediterranean towards the southern, and the Sahara has constituted, at least in the more recent geological epochs, an insurmountable barrier for most species.

Combining in this way the facts furnished by geology on the one hand, and palæontology on the other, we can arrive at certain conclusions regarding the origin of the mammals and their geographical distribution, conclusions which must be summed up in the subdivision of the class. Of this we give a tentative sketch.

Subdivision of the Mammals based on the presumed Order of Evolution.—Passing over in the meantime the aplacental mammals, the marsupials and monotremes, reserving all that we have to say on this lowest group for the chapters in which we deal with the two orders named, we call to mind by way of preface only these facts: that the oldest mammalian remains are found in the upper Trias; that the only complete jaw known from that epoch, the jaw of the Dromatherium found in North America, is incontestably that of a small insectivore; that the remains derived from the Oolitic strata of Stonesfield and the Purbeck limestones belonging to the upper Jura in England, and from the United States, likewise show in great part an insectivorous dentition; that, however, genera are to be found among them in which the dentition is allied to that of the kangaroo-rats; and that, finally, the last representatives of the marsupials from the Eocene deposits in France exhibit striking affinities to the opossums of America.

The history of the evolution of the placental mammals, or, in technical language, their phylogenetic history, begins with the Tertiary formations. With these a number of placental forms suddenly make their appearance, and in the various subdivisions of the Tertiary epoch, the Eocene, Miocene, and Pliocene, as well as in the subsequent Quaternary epoch and the present age, the number of these forms goes on increasing, and the families and tribes still subsisting are gradually developed.

But it must be remembered that beneath the Tertiary formations there is a vast gap. The rocks lying beneath the Tertiary in the geological scale are the Cretaceous, and from them we know of no mammalian remains whatever. Beneath the Cretaceous again are the Jurassic and Triassic strata, in which we have indeed mammalian remains, but these solely of aplacental forms. What, then, was the history of the mammals during the intervening period? When did the primitive stocks of the present placental forms first make their appearance?

Can we fill up the gap by supposing that there arose at some period within it a single placental type from which all the present forms are descended? Or must we assume more than one primitive placental stock to account for the present divergences among the members of the class? The answers to these questions must necessarily be based largely on speculation, and though the facts that have been ascertained may justify pretty confident conclusions with regard to some of them, we are inevitably restricted to hypothesis when we attempt to trace the history or evolution of any particular group.

So much, however, is certain. After the long gap between Jurassic and Tertiary times there appear with the Eocene both in the Old World and the New the following still surviving orders: Prosimii, Insectivora, Carnivora, Perissodactyla, Artiodactyla, Rodentia, and in the Old World alone, the Chiroptera. All these orders are represented either by families which are now quite extinct, or by equivocal types which cannot be referred to any family, or, lastly, by forms still existing. Thus the Prosimii in France have furnished a genus allied to the Potto, while the other families are extinct. Further, leaf-nosed and smooth-nosed forms are found among the bats; tanrecs, moles, and shrews among the Insectivora; Canida and Viverrida among the Carnivora; tapirs and horses among the Perissodactyla; pigs among the Artiodactyla; squirrels, dormice, mice, degus (genus Octodon), and spiny rats (Echimyida) among the rodents, together with extinct families and indeterminate types, from which families better characterized can be derived.

This accordingly is the oldest nobility among the placental mammals, whose family trees can be traced back to the Eocene. The roots manifestly reach much further back, but we have no certain knowledge of them.

Let us now consider this fact in the light of the present distribution of mammalian forms. Seeing that all these orders in families already existed in Eocene times, if there is any region of the globe from which they are altogether absent, or in which they are poorly represented, that deficiency must be accounted for. It is universally found that when a higher type appears it tends to displace the lower. The latter becomes extinct, or gets reduced to a few representatives enabled by special circumstances or habits to survive. They may escape even amidst the competition of higher forms through the fact of their living on trees, and thus being out of the reach of many enemies, or through being able to hide in burrows, or being nocturnal in their mode of life. But, apart from such special favouring conditions, the doom of the lower type is to disappear before the higher, and since the higher placental forms were already largely represented in Eocene times, we must ask how it is that any region of the earth has escaped being overrun by them.

Such a region does exist in Australia and some of the neighbouring islands. The fauna of that region comprises but few placental forms among its mammals, but a great number and variety of such as have no placenta. There is only one way of accounting for such a fact as this. Before the appearance of the chief representatives of the placental type, that is to say, before the Eocene epoch, the Australian region must have been cut off from the other lands of the globe; it must thus have been saved from that struggle for existence in which the higher forms of the Eocene epoch took part.

Passing on now to the Miocene we find that in that epoch the number of the orders is completed. None of the orders of the present day is wanting in Miocene formations. Monkeys, seals, whales, sea-cows, elephants, and edentates all appear. The families become specialized, the monkeys of the Old and New World, hedgehogs, felines, hyænas, martens and bears, rhinoceroses and hippopotamuses, as well as ruminants, can be more and more clearly discriminated. In short we see how in the strata of the Miocene the types follow one another in higher and higher degrees of specialization.

It is clear, moreover, that those regions which present to our view only the orders appearing first in the Eocene, and which are without the orders originating in the Miocene, were isolated before the latter epoch, though not till after the Eocene.

In this position are Madagascar and the Antilles. The great African island is mainly inhabited by prosimians; but there are found in addition bats, insectivores, rodents, a species of pig, viverrines, and the old type Cryptoprocta. No vestiges, however, have yet been found there of any order or family belonging to the Miocene—neither monkeys, nor ruminants, nor edentates, which are all so abundant, nevertheless, both on the mainland of Africa and in India. The Antilles present an analogous case, differing only in the details. The

Miocene orders and families are there unknown; the monkeys, edentates, ruminants, and carnivores, so widely diffused on the neighbouring mainland, are all alike absent here; the bats and rodents, which are found on these islands, belong to an ancient Eocene nobility, and so also do the insectivores, which are wholly wanting on the mainland of South America.

These two regions have followed a separate course of development, at least since the Eocene period.

And here now we are met by another fact. If the Eocene and Miocene genera found on the two hemispheres and described by palæontologists are compared, we find with astonishment that, with the exception of two genera belonging to the Perissodactyla, the genera Coryphodon and Lophiotherium, derived from the earliest Eocene strata, there are none common to both hemispheres. What conclusion must be deduced from this fact? Assuredly none but this, that the two great divisions of the earth were already separate in those times. But there are in both corresponding series in the evolution of mammalian forms; monkeys, horses, ruminants, and carnivores exhibit parallel series on the two sides of the ocean.

In the Pliocene and Quaternary periods the two hemispheres are not so sharply distinguished in the north. In the Quaternary, in which the polar species of the two hemispheres advanced in general further to the south, there is not only, as at present, similarity but entire agreement. These facts made the adoption of a separate circumpolar region necessary. We cannot associate this region with those immediately to the south, when we find that the latter are not only absolutely distinct on the two sides of the ocean at the present day, but were equally distinct to the northern shores of the respective continents down to a period geologically recent.

The two parts of the mainland of America are connected by the Isthmus of Panama, by means of which many an interchange has taken place. But on the whole the two land-masses referred to are astonishingly different. North America, the Nearctic region, has neither monkeys, nor manatees, nor tapirs, camels, agoutis, or edentates, like South America, the Neotropical region, which again has neither insectivores, nor hollow-horned ruminants or pouched rats. These two regions are accordingly sharply marked off from one another.

Quite different is it, however, with the three regions of the Old World. The Palæarctic region has neither edentates, prosimians, nor elephants, which the other two regions possess; but for the most part it is necessary to descend to families and even to genera in order to make out general distinctions between the three regions. We must also grant that their boundaries become obliterated when we go back from the present time to earlier periods. The three regions finally merge entirely into one. In the Miocene and Eocene periods the Palæarctic region had edentates, giraffes, and prosimians, and as late as the Quaternary period elephants, hippopotamuses, rhinoceroses, and hyænas. The present limits of the region have accordingly only gradually been established.

If we now go on to consider the classification which may be deduced from and ought to sum up all the results of biological, developmental, and geographical investigations, we must confess that considerable impediments stand in the way. First of all we recognize the perfectly clear and sharp distinction between aplacental and placental mammals, but after we have got so far we find the principles of a further subdivision, especially of the placental mammals, difficult to determine.

The Eocene orders furnish us with nailed and hoofed forms, Deciduata and Indeciduata, forms with diffuse, zonary, and discoidal placentas, with complete and incomplete dentition. All these above-named orders cannot be derived from one another. If, as is very probable, they are all descended from marsupial stocks, they must trace back their descent along several lines of different origin. Let us take for granted for an instant this descent from a marsupial ancestry, and see what conclusions may be deduced therefrom. Such conclusions can be based only on the dental system, which is all that is known to us in the case of the earliest mammals.

Presumable Relations of existing Placental Orders to a Marsupial Ancestry as shown by the Dental Characters.—The insectivorous type is the oldest. We have seen that the marsupials of the Trias and Oolitic (Jura) periods are insectivores. This is accordingly a very old, perhaps even the primitive stock.

The bats are only flying insectivores. If we unite the insectivores with webbed feet and those with the toes free, we might also, without being guilty of any great offence, add to the same group those with flying membranes.

Some Prosimii are manifestly insectivores. They are probably descended accordingly from insectivorous marsupials. Others, however, likewise very old forms, resemble hoofed mammals, especially Artiodactyla, in dentition. Even the placenta bespeaks a close affinity to the latter. Very probably, therefore, our present mode of division unites in a single order animals which are derived from quite different ancestors, but which have approached one another in respect of a number of secondary characters.

The same holds good also of the apes and monkeys, which cannot be derived from a single ancestor. On their first appearance in the lower Miocene the Simiæ of the New World are as different from those of the Old as they are at the present day. Moreover, there are Simiæ which are rather insectivorous in their habits, while others again approach more nearly the carnivorous and omnivorous forms.

We should thus have a group of orders, the Chiroptera, Prosimii, and Simiæ, which might, at least in part, be placed very near the old Insectivora.

Take now the Carnivora. We know even in Jurassic strata marsupials whose dentition approaches the carnivorous type, and from more recent strata, as well as the fauna of the present era, we are acquainted with many, which, if we may so express ourselves, are more carnivorous than the placental carnivores. The Hyænodons are an unmistakable connecting link. The Carnivora are accordingly descended without doubt from marsupials. The seals, as we have already mentioned, are only a branch of this group adapted to an aquatic mode of life.

The Perissodactyla and Artiodactyla belong to the Eocene nobility. May we perhaps connect them with the Jurassic genus Stereognathus? However that may be, these two orders form, so to speak, trees, whose original trunks, the tapirs and pigs, have continued on to our own day. Both stems have put forth many branches now extinct, which we cannot here enumerate, but the Solidungula and rhinoceroses form series which have developed from the ancient Perissodactyla, the former from those of Eocene, the latter those of Miocene times. Very probably the Proboscidea and Sirenia are also to be reckoned to this group. Further, there is probably no doubt as to the fact that the ruminants and hippopotamuses are descended from the first Artiodactyla, the pigs. In these two great orders, also, the marked distinction between the primitive stocks of the Old and the New World is plainly manifest.

The rodents of the Eocene nobility cannot be traced with certainty from any marsupial form. Only the genus Plagiaulax, from Jurassic times, exhibits certain distant resemblances. The members of this order have remained what they were at first; they have not essentially altered throughout the whole geological period in which they are known.

The same is the case with the edentates. This group is manifestly made up of the descendants of several ancestors; but we can only trace them back to the Miocene, and in doing so we cannot discover any unequivocal relations to older types.

From all this two main conclusions in our opinion may be drawn. First, that it is a perfectly groundless hypothesis, that the mammals can all be traced back to a single stock; and, second, that the various original stocks, which we feel compelled to assume, have developed, in the regions to which they are confined, independently of each other, and often in such a manner that the ultimate forms which they have attained have more resemblance to each other than the types from which they have proceeded.

In the body of the present work we have subdivided the mammals in accordance with the points of view which we have just explained. We follow the series from the most perfect forms, those standing nearest to man, the Simiæ, down to the types with the lowest organization. The aplacental forms, the marsupials and monotremes, were obliged to take the last place; and among the placental forms the edentates and rodents undoubtedly form the lowest steps in the ladder. After the Simiæ the orders standing next to the stem-group of the Insectivora, namely the Prosimii and Chiroptera, naturally range themselves in immediate succession, and then follow the Carnivora, among which the Pinnipedia (seals) form the transition to the whales, with which again are connected the Sirenia and Proboscidea as transitions to the Even-toed Ungulates (Artiodactyla).

The table on page 18 exhibits these subdivisions, with their general characters, in the order in which they are treated in the body of the work.

TABLE OF THE ORDERS, FAMILIES, AND TRIBES OF THE MAMMALIA.

APES AND MONKEYS (*Simiæ*).

Tropical mammals more or less like man, with complete dentition, opposable thumb and great toe (Quadrumana), cup-shaped closed bony orbit, two pectoral mammæ, and discoidal placenta.

(A) Monkeys of the Old World (*Catarrhinæ*). With 32 teeth and narrow septum between the nostrils, which are directed somewhat forwards.

Anthropoid Apes (*Anthropomorphæ*). Tailless, with naked face somewhat resembling that of man; body covered with long hairs.

Black Anthropoid Apes (*Troglodytes*). With fore-limbs reaching no further than the ankles, and thirteen pairs of ribs; natives of Africa.

Red Anthropoid Apes (*Simia*). With very long arms and twelve pairs of ribs; natives of the East Indies.

Gibbons (*Hylobates*). Asiatic arboreal apes, with extraordinarily long arms and hands, and small naked spots on the buttocks.

Tailed Monkeys (*Caudatæ*). With more or less developed tail, ischial callosities, and mostly also cheek-pouches.

Semnopitheci. Arboreal monkeys of slender shape, with well-developed thumbs, long tails, a compound stomach of three parts, and sometimes with, sometimes without, cheek-pouches.

Colobi. African forms resembling the Semnopitheci, but with more powerful jaws and much reduced thumb, and without cheek-pouches.

Guenons (*Cercopithecus*). African monkeys with simple stomach, cheek-pouches, long tail, large thumb, and moderately long limbs.

Macaques (*Macacus*). With a solitary exception Asiatic monkeys, with a rather thickset frame, protruding muzzle, tolerably powerful jaws, simple stomach, cheek-pouches, and a tail which never grows longer than the whole body.

Baboons (*Cynocephalus*). Large, chiefly African, terrestrial forms, with dog-like muzzle, powerful limbs, and dentition like that of a carnivore.

(B) Monkeys of the New World (*Platyrrhinæ*). With 36 teeth and broad nasal septum; the nostrils directed sidewards; ischial callosities and cheek-pouches always absent.

Naked-tailed Monkeys (*Gymnuræ*). The long and powerful tail has at least the last third naked on the under surface, where it is covered with rough skin; and the tail serves as an organ of touch and prehension.

The Howlers (*Mycetes*).

The Woolly Monkeys (*Lagothrix*).

The Spider Monkeys (*Ateles*).

The Sajous (*Cebidæ*). Tail long and strong, completely covered with hair, and serving only as an organ of prehension (not of touch).

The Sakis (*Anecturæ*). Tail of various length, the vertebræ not increasing in size towards the extremity; never used for prehension.

(C) The Clawed Monkeys (*Arctopitheci*). With 32 teeth, fore-paws without an opposable pollex (thumb), all the digits except the hallux (great toe) provided with claws.

THE PROSIMIANS (*Prosimii*).

Climbing animals with complete dentition, opposable thumb and great toe (Quadrumana), bony orbit not closed behind, mostly more than two teats, and with a campanulate (diffuse) placenta.

The Prosimians of Madagascar.

The Lemurs (*Lemurida*). } Distinguished by their dentition: see text.
The Indris (*Indrisida*). }

The Aye-aye. A single species forming a family by itself, with a peculiar dentition like that of a rodent, and with a very long middle digit on the fore-foot.

The African Prosimians.

The Potto Family (*Pterodictida*). A family with small ears, short tail, and rudimentary index.

The Galago Family (*Galagonida*). Composed of a single genus with long ears and tail, digits complete, and all provided with flat nails, except the second digit of the hind foot, which carries a claw.

The East Indian Prosimians.

The Loris (*Lorisida*). A family resembling the Pottos, with rudimentary index and tail.

The Tarsier. A single species forming a family by itself; distinguished by its enormous eyes and greatly elongated tarsus.

The Colugos or Flying Cats (*Galeopithecus*). A highly remarkable genus forming a separate family distinguished by the possession of a patagium, or parachute-like membrane, and a very peculiar dentition.

THE BATS (*Chiroptera*).

Mammals distinguished by the possession of wings formed by a membrane attached to the body and commonly also to the hind limbs and tail, and capable of being extended by the remarkably elongated digits of the fore-limbs; complete dentition; two pectoral mammæ; discoidal placenta.

The Fruit-eating Bats (*Carpophaga*).

Flying Foxes (*Pteropida*). Bats with flattened masticating molars and mostly with a clawed index or second finger; snout long.

The Insect-eating Bats (*Entomophaga*).

True Bats or Vespertilionida (*Gymnorhina*). The simple nose at the extremity of the snout without leaf-like appendages.

Leaf-nosed Bats (*Phyllostomata*). Bats with membranous appendages to the nose, mostly supported by thin plates of cartilage.

THE INSECT-EATERS (*Insectivora*).

Small plantigrade mammals with a discoidal placenta and all three kinds of teeth; mostly five-clawed toes on all four feet.

The Banxrings or Climbers (*Tupaiæ*), resembling squirrels, with a sharp naked muzzle, and long tufted tail.

The Jumping Shrews (*Macroscelida*). Resembling jerboas, but with a long snout or proboscis; natives of Africa.

The Desmans or Divers (*Myogalida*). With swimming feet, long proboscis, and flattened tail.

The Shrews or Runners (*Soricida*). The body resembling that of a mouse, but with a pointed muzzle and short, almost naked, tail.

The Crawlers forming two groups:—

The Tanrecs (*Centetida*). Natives of Madagascar, with the general appearance of our hedgehogs.

The Hedgehogs (*Erinacei*). Natives of the continents of the Old World, with the body completely covered with spines.

The Burrowers. Having the anterior extremities modified into powerful delving instruments; also forming two groups—

The Moles (*Talpida*). The digging feet with five digits.

The Golden Moles (*Chrysochlorida*). Moles belonging to the Cape, with a short thickset body, only three digits on the digging feet, and rainbow reflex colours on the fur.

THE FLESH-EATERS (*Carnivora*).

Mammals with zonary placenta, free clawed toes, well-developed canines and more or less cutting molars.

The Dog Tribe (*Canida*). Digitigrade carnivores with long running legs, five free toes on the fore-feet, four on the hind-feet, and in most cases 42 teeth.

The Dogs Proper (*Canis*). With five toes in front, four behind, and 42 teeth.

Group of the Wolves. Round pupils.

Group of the Foxes. Vertical oval pupils.

The Hyænas (*Hyænida*). Digitigrade carnivores with powerful body decreasing in size from before backwards, mostly with four toes on all four feet, and at most 34 teeth.

The Cat Tribe (*Felida*). Digitigrade carnivores mostly with retractile claws and never more than 30 teeth.

The Cheetahs (*Cynailurus*).

The True Felines (*Felis*).

Felines of the Old World.

Felines of the New World.

The Lynxes (*Lynx*).

Fossa (*Cryptoprocta*).

The Viverrines (*Viverrida*). Carnivora of small or at most of moderate size, with short legs, and two permanent molars in each half of each jaw.

The Civets (*Ailuropoda*). Digitigrade viverrines with retractile claws.

The Mangoustis (*Cynopoda*). Viverrines with elongated toes, large non-retractile claws, and naked soles.

The Bears (*Ursida*). Plantigrade carnivores often with a clumsy thickset body, with a degraded and often scarcely recognizable carnassial and large tubercled teeth.

The Small Bears (*Subursida*). With 36–40 teeth and a long tail.

The Large Bears (*Ursida*). With 42 teeth, including four premolars above and below, two molars in the upper jaw, three in the lower, all with flat wrinkled crowns, furnished with low blunt tubercles.

The Badger and Weasel Family (*Mustelidæ*). Except a single species all the Carnivora belonging to this family have a single large tubercled tooth in each half of the upper, and two molars in each half of the lower jaw.

Badgers (*Melidæ*). Plantigrade carnivores with thickset clumsy body, short feet, and highly developed anal glands.

Martens (*Martidæ*). Mostly digitigrade, with long and even worm-like body, frequently retractile claws, and usually a long bushy tail; the upper tubercled tooth small and transversely placed, the upper carnassial sharp and with a horizontal process in front.

Otters (*Lutridæ*). Aquatic Mustelidæ with long but stout cylindrical body, short webbed feet, and flattened tail.

THE SEALS (*Pinnipedia*).

Aquatic carnivores with feet converted into flippers, spindle-shaped body, complete dentition, and zonary placenta.

The Eared Seals (*Otaridæ*). Provided with external ears.

The True Seals (*Phocidæ*). Without external ears and with short limbs.

The Walrus (*Trichechus*). Armed with tusks.

WHALES AND DOLPHINS (*Cetacea*).

Fish-like carnivores without hind-limbs, and having the fore-limbs converted into flippers, the tail in the form of a horizontal fin. The nostrils (blow-holes) are situated on the summit of the forehead; the ill-developed lips have no moustache hairs, the skin is naked, the placenta diffuse, and the teats situated far back in the abdominal region.

Toothed Whales (*Denticete*).

Dolphins (*Delphinidæ*). With a larger or smaller number of uniform teeth in both jaws; feed exclusively on fishes.

The Sperm Whale Family (*Physeteridæ*). With fully developed teeth only in the lower jaw.

Whale-bone Whales (*Mysticete*).

Fin-backed Whales (*Balænopteridæ*).

Right Whales (*Balænidæ*).

THE SEA-COWS (*Sirenia*).

Fish-like herbivora without dorsal or ventral fins, with a small head and distinct neck, thick lips set with tactile hairs, molars with broad crowns, nostrils at the end of the muzzle, and pectoral teats.

THE ELEPHANTS (*Proboscidea*).

Large animals whose nose is prolonged into a proboscis which serves as a prehensile and tactile organ, with column-like legs, and feet with five toes united into a mass and covered with flattened hoofs; the upper incisors mostly in the form of tusks; no canines; compound molars; placenta zonary.

THE ODD-TOED UNGULATES (*Perissodactyla*).

Hoofed animals mostly of large size, usually with an odd number of toes on both pairs of feet, the middle toe being the one that continues the axis of the leg. The thigh-bone has a third trochanter; dentition complete; stomach simple; teats abdominal or inguinal; placenta usually diffuse and composed of separate cotyledons distributed over the whole surface of the ovum or embryo.

The Rock-badger Family (*Hyracidæ*). With four toes in front, three behind, and certain rodent-like characters in the dentition.

The Tapir Family (*Tapiridæ*). Composed of animals somewhat resembling large pigs, but distinguished by the possession of four hoofed toes in front, three behind, and a short mobile proboscis.

The Rhinoceros Family (*Nasicornia*). Composed of a single genus of huge clumsy animals, with three toes both in front and behind, one or two formidable horns composed solely of horny matter, and a peculiar dentition.

The Horse Family (*Equidæ*). A family represented at the present day by only a single well-marked genus, with shapely body, long slender legs terminating in only a single digit (the middle one), but comprising also a number of extinct forms with a greater number of digits both on the fore- and hind-feet.

THE EVEN-TOED UNGULATES (*Artiodactyla*).

Hoofed animals of very variable size, almost always with an even number of toes, which are arranged about two parallel axes running through the middle line of the second and fourth digits. The thigh-bone has no third trochanter. The stomach shows a tendency to subdivision. The originally complete dentition gets gradually specialized and reduced. The teats are abdominal and inguinal; placenta diffuse.

Non-ruminant Artiodactyla (*Polydactyla*). With more than two digits.

The Hippopotamus or River-horse Family (*Obesa*). Composed of the single genus Hippopotamus, consisting of huge clumsy animals, with very thick hides, four toes both on the fore- and hind-feet, and a highly remarkable dentition.

The Pig Family (*Suidæ*). With large and thick but tapering head terminating in a snout, the end of which is in the form of a tough round disk, and in all cases, except the peccaries, having the canines of the upper jaw directed upwards.

THE RUMINANTS (*Didactyla* or *Ruminantia*). With only two digits, and with a complex stomach adapted to the process of chewing the cud.

THE CHEVROTAIN FAMILY (*Tragulida*). With metacarpal and metatarsal bones not completely fused into a cannon bone, with a low structure of brain, and without a psalterium in the complex stomach.

THE DEER FAMILY (*Cervida*). The males (and in the reindeer the females also) with horns in the form of antlers.

THE HOLLOW-HORNED RUMINANTS (*Cavicornia*). Horns composed of horny matter with a hollow core in which rise bony processes from the skull.

THE ANTELOPES.
THE GOATS.
THE IBEX.
THE SHEEP.
THE OX FAMILY.
THE BUFFALO.
THE BISON.
THE TRUE OXEN.

THE GIRAFFE FAMILY (*Devexa*). Composed of a single species, with very long neck, high shoulders, long flexible tongue, and hair-clad horns in the form of bony out-growths from the front margin of the occipital bone.

THE CAMEL FAMILY (*Camelida*). With feet resting on callous pads, and, unlike other ruminants, with incisors in the upper jaw, besides other peculiarities in the dentition.

THE CAMELS.
THE LLAMAS.

THE GNAWERS OR RODENTS (*Rodentia*).

Claw-bearing mammals with incomplete dentition, having only two large rootless functional incisors in the upper and lower jaw, no canines, and cheek-teeth almost uniform, arranged in a continuous series and separated from the incisors by a wide diastema. Placenta discoidal.

THE SQUIRREL FAMILY (*Sciurida*). With a strong clavicle, four free digits on the fore-feet and three on the hind-feet, all armed with strong claws, and with a peculiar dentition (usually five molars in the upper jaw, and all the molars with triangular crowns).

THE SQUIRRELS.
THE MARMOTS.

THE DORMOUSE FAMILY (*Myoxida*). Distinguished from the previous family chiefly by the dentition (only four molars in the upper as well as in the under jaw, and all the molars with transverse plates of enamel).

THE BEAVER FAMILY. A family consisting only of a single species (*Castor fiber*), of considerable size, with five toes both on the fore and hind feet, those on the hind feet united by a web.

THE MOUSE FAMILY (*Murida*). A family composed of a great variety of forms, presenting numerous transition links, with clavicles, usually four digits and the rudiment of a pollex on the fore-feet and five digits on the hind-feet, and usually only three molars.

MOLE-RATS.
HAMSTERS.
RATS AND MICE.
FIELD MICE.

THE JERBOA FAMILY (*Dipodida*). Distinguished by their very long hind-legs adapted for jumping, the excessive length being due to the great elongation both of the tibia and the metatarsus.

THE PORCUPINE FAMILY (*Hystricida*). Distinguished by their covering of spines on the back, serving as a defensive armour.

THE SPINY RAT FAMILY (*Echimyida*). With four molars with enamel folds, sometimes simple, sometimes complex, the fur generally coarse and sometimes interspersed with spines.

THE DEGU FAMILY (*Octodontida*). With the enamel folds on the grinding surface of the molars arranged in the form of the figure 8.

THE CHINCHILLA FAMILY (*Chinchillida*). Distinguished by the possession of four rootless molars divided into two, or at most three, separate transverse ridges by continuous folds of enamel.

THE AGOUTI FAMILY (*Subungulata*). Distinguished by the peculiar structure of the digits, which carry a kind of hoof in place of claws or nails.

THE RABBIT FAMILY (*Leporida*). Distinguished by the possession of two small incisors in the upper jaw, placed behind the two functional incisors.

THE EDENTATES (*Edentata*).

Placental mammals with incomplete dentition and rootless teeth without enamel. The free digits carry hoofs transformed into sickle-shaped claws.

THE SLOTHS (*Bradypoda*). With very long fore-limbs, incomplete zygomatic arch, and descending process from the cheek-bone.

THE ARMADILLOS (*Dasypoda*). With a very strong bony framework, part of which is adapted to support an outer skeleton or armour, composed of small plates, usually hexagonal in form, placed side by side.

THE WORM-TONGUED EDENTATES (*Vermilinguia*). Distinguished by the possession of long worm-like tongues, always coated with an adhesive saliva, which enables them to be used as organs of prehension.

THE ANT-EATERS.

THE PANGOLINS.

THE MARSUPIALS or POUCH-BEARING MAMMALS (*Marsupialia*).

Non-placental mammals with free digits bearing nails or claws. The young are born in a very imperfect condition, and complete their development attached to teats situated in an external abdominal pouch (marsupium) supported by two special bones (marsupial bones) attached to the pelvis. The dentition is usually complete but permanent, except in the case of a single premolar, which is shed and renewed. The lower angle of the lower jaw behind is turned inwards.

THE OPOSSUMS (*Didelphyida*). With five digits on all four feet, and with a very long and strong hallux, which is completely opposable as in monkeys.

THE PREDACEOUS MARSUPIALS (*Rapacia*).

THE PERAMELES FAMILY (*Peramelida*). Long-eared marsupials with tubercles on the molar teeth, adapting them for crushing insects, the first digit of the fore-feet represented only by a wart or tubercle, that of the hind-feet entirely absent, while the second and third digits in the hind-feet are very thin and united together down to the claws.

THE DASYURE FAMILY (*Dasyurida*). With a more or less well-marked carnivorous dentition.

THE FRUIT-EATING MARSUPIALS (*Carpophaga*).

THE PHALANGER FAMILY (*Phalangistida*). With the second and third digits of the hind-feet united, a nailless opposable hallux, and well-developed marsupial pouch.

THE HERBIVOROUS MARSUPIALS (*Poephaga*). Composed of forms well adapted for leaping; always with five digits, armed with strong claws on the short fore-limbs, and very long hind-limbs fitted to bear the whole weight of the body.

THE ROOT-EATING MARSUPIALS (*Rhizophaga*). Composed only of a single genus, the wombats (*Phascolomys*), with a dentition exactly like that of a rodent.

THE MONOTREMES (*Monotremata*).

Non-placental mammals without true teeth, with the genital and urinary ducts opening along with the rectum into a common chamber (cloaca). They have neither marsupial pouch nor teats, but have milk-glands and marsupial bones.

THE ORNITHORHYNCHUS.

THE ECHIDNA.

NOTE

ON POINTS CONNECTED WITH GEOLOGY REFERRED TO IN THIS WORK.

In the following pages a section under each order of the Mammals is devoted to the question of the presumed origin or descent of the group, which involves the consideration of its distribution in time. With the view of assisting the reader in following the reasonings in the sections alluded to, a geological table showing the sequence of the rocks forming the crust of the earth is here added. Where subordinate members of the systems given in this table are mentioned in the text, such sub-divisions, for example, as the Keuper or New Red Marl, or local formations, like the Stonesfield Slates, or the Purbeck Beds, an indication is always given of the system to which they belong, so that a reference to this table will enable the reader to understand in a general way the relative order in time of the extinct forms spoken of.

It may here be mentioned, however, that the order of the strata, as shown in this table, must not be understood as giving any indication of the length of time separating forms belonging to different systems. The thickness of the rocks composing these systems varies greatly, and there is presumably a corresponding variation in the length of time that has elapsed during their formation. Thus, though the first Mammalian remains are found in the Trias, it may be inferred from the thickness of the British strata, that the interval between their first occurrence and the present epoch, is enormously less than that which had previously elapsed from the time of the oldest stratified rocks.

It need hardly be observed that in the following table, as in all similar tables, the oldest strata are those which are placed at the bottom. The Archæan or Eozoic rocks contain the earliest organic remains known to exist, and such remains become more and more numerous as we ascend the scale. It is in accordance with the general character of these remains that the rocks are subdivided into the systems mentioned in the table, but it is not till we come to the rocks classed as "Recent" that we meet with any subdivision based on the character of the Mammalian remains. The rocks or deposits so termed are distinguished from the Pleistocene, or those forming the other member of the Quaternary series, by the fact that in them all the mammals belong to species still living, while the latter contain the fossil remains of many extinct mammals, as well as others derived from forms surviving at the present day.

GEOLOGICAL TABLE,

SHOWING IN ASCENDING ORDER THE MAIN ROCK-SYSTEMS INTO WHICH THE CRUST OF THE EARTH IS DIVIDED.

Post-Tertiary or Quaternary, ...	Recent—Alluvium, Peat, &c.	
	Pleistocene.	
Tertiary or Kainozoic, ...	Pliocene.	
	Miocene.	
	Eocene.	
Secondary or Mesozoic, ...	Cretaceous.	
	Jurassic.	Oolitic.
		Liassic.
	Triassic.	
Primary or Palæozoic, ...	Permian.	
	Carboniferous.	
	Devonian and Old Red Sandstone.	
	Silurian.	
	Cambrian.	
Archæan or Eozoic, ...	Fundamental Gneiss.	

.IBRARY
O· THE
VERSITY
OF
IFORNIA

APES AND MONKEYS

(SIMIÆ).

Tropical mammals more or less like man, with complete dentition, opposable thumb and great-toe (Quadrumana), cup-shaped closed bony orbit, two pectoral mammæ, and discoidal placenta.

* * *

THE apes and monkeys must always have struck men as being exceedingly humanlike in their general form and structure. So much so, that the great medical writer Galen, as was demonstrated by Vesalius, ascribed to the human frame several details of structure that he could only have observed in dissecting the well-known magot or Barbary Ape: Linnæus, again, the founder of modern zoology, placed the orang-utang in the same genus with man, distinguishing them merely as species. Modern science, however, renders this error no longer possible.

There has been more controversy over the question of the relation of man to the Simiæ than would have been possible if the disputants had limited themselves to purely zoological characters, and had not drawn into the discussion the whole sphere of man's intellectual development and capacity for development. If our object were to give a complete account of the whole class of the Mammalia, as that class must be understood in the science of zoology, unquestionably we should have been compelled to include man, who is a mammal, neither more nor less, down to the smallest feature of his internal and external organization. That is a truth that cannot be shaken. But since, even apart from intellectual qualities and their development, the study of man as a part of nature has become the subject of a comprehensive science, Anthropology, we have had to confine ourselves to the other mammals. Here now it is a matter of perfect indifference for our present purpose what relative value one would assign to the specific characters of the bodily structure of man; for even although one must acknowledge the entire truth of the well-known saying, that there is less difference between man and the anthropoid apes than between these and the lowest of the Simiæ, yet within these limits various views may be maintained as to the value of the boundary lines between the different groups.

The likeness of the Simiæ to man is undisputed, but it is not the same in all members of that group. It grows gradually less from the large anthropoid apes down to the baboons and the Arctopitheci; and if the members of one group manifest a striking resemblance in the general form of the body, in their bearing and mode of using the limbs, those of the last group approach so near the squirrels and other climbing animals or Carnivora in external appearance, demeanour, and mode of life, that it requires a pretty close examination to ascertain the differences between these groups.

Let us take a closer look at the bodily resemblances and differences, for it is only these that come under consideration here in the first instance. The resemblances are more prominent in the young, the differences in the adult. I was drawing a mature embryo of the black ape (*Cynocephalus* (*Cynopithecus*) *niger*), when a lady, who had shortly before presented her husband with a son, stepped in. "Good gracious!" she exclaimed, "exactly the portrait of my little Jean Jacques."

The rounded head with generally flat nose and nostrils placed very near each other, the well-formed neck, the form of the trunk, and above all the entire freedom of the limbs mark the external resemblance to man, a resemblance, however, which is, to be sure, a good deal diminished in most of the Simiæ by the existence of a longer or shorter tail. But we hasten to add that in the anthropoid apes and some other species, as the Barbary ape, this appendage is altogether wanting. A less striking difference is presented by the covering of hair, which in most of the Simiæ is complete, and in some even forms a kind of woolly fur. This distinction cannot indeed be called an absolute one, for between the scanty hair-covering of some of the Simiæ and the abundant hair-covering of many races of man it is just as impossible to draw a sharp boundary line as it is to indicate any such line of demarcation with respect to the distribution and direction of the hair on certain parts of the body. In man the front of the body is much more hairy than the back, which must probably be regarded as a consequence of the usual attitude of man, since it is always those parts which are most in need of protection that are most abundantly covered with hair. The ape or monkey, which holds itself erect only in exceptional cases, exposes the back parts to the changes of the weather, and these accordingly are the more plentifully covered with hair; the naked savage, on the other hand, standing erect exposes the crown of the head and the front more than any other parts, and hence has these parts most abundantly supplied with hair. With respect to the direction of the hair the anthropoid apes agree with man in having the hair on the fore-arm directed backwards towards the elbow, while the other Simiæ and other mammals generally have the hair on the corresponding parts directed downwards.

Let us now consider more closely the structure of the skeleton, and first that of the skull.

The skull of the very young in all mammals including man is characterized by the predominance of the cranial over the facial region, the latter of which has its form and proportions determined chiefly by the development of the jaws. In man as in the Simiæ the jaws grow gradually forwards with advancing years in consequence of the growth of the teeth; but while even in those races of man which have teeth slanting forwards (the Prognathi) this protrusion is confined within narrow limits, in the Simiæ, and especially in the low terrestrial forms, the Cynomorphæ, it is so considerable that we have here similar relations to what we find in the Carnivora, the cranial region lying for the most part not above but behind the facial. But in this as in many other cases the gradual development of this feature can be considered under three aspects, namely, as affected by age, by sex, and by the position in the scale of being. In the female sex the jaws and the muscles moving them are less developed than in the male; in the higher Simiæ the jaws protrude less than in the lower. With the development of the jaws and their muscles is connected in the most intimate manner that of the surfaces, crests, and ridges of the skull to which the muscles are attached; and considering the development of these crests and ridges under the three aspects just mentioned, we may observe that in the young and in females they are often scarcely more prominent than in man, while in the males of many species they are not less developed than in the heavy-armed Carnivora.

In all circumstances, however, the cranial region in the Simiæ is, in consequence of the smaller size of the brain, much smaller than in man, and we are justified in saying that the most essential distinction between the two groups consists in peculiarities which result from this predominant development of the human brain.

While in man the osseous brain-case with its contents arches over the facial region in such a manner that the latter comes to lie almost entirely under and not in front of the former, the centre of gravity of the skull and of the whole head is at the same time transposed forwards, so as to have the effect of making the upright position the normal attitude of the body. In those Simiæ which most closely resemble the lower animals as regards the structure of the jaws, namely, the baboons, the head, as in all other four-footed mammals, is attached by strong muscles and nuchal ligaments, so that its support always demands a considerable degree of muscular exertion, in consequence of which the processes of the neck vertebræ to which the nuchal ligaments are attached are correspondingly elongated and strengthened. In man, on the other hand, the head is in a state of equilibrium on the spinal column when he stands erect, and no further muscular exertion is required to keep it in that position. These relations necessarily affect the position of the occipital articulation, and the opening or foramen between the two occipital condyles through which the spinal column is prolonged into the cranial cavity so as to become continuous with the brain-mass. From the posterior surface of the skull, where this foramen is found in the lower Simiæ, it moves gradually down in the higher species till at last it comes to occupy in man the middle of the base of the skull.

Anatomists are now agreed upon this, that the brain of the Simiæ is constructed exactly on the same plan as that of man, that no part is wanting to the former which is present in the latter; that the fissures which intersect the brain-mass and the lobes and convolutions lying between them are absolutely identical, and are distinguished only in this, that their forms become in man all the more complicated the larger the mass becomes, besides which the greater or smaller relative importance of individual lobes and fissures must also be taken into account. But in this case also the gradual development, both from infancy to the adult condition, and also from race to race or species to species, can be demonstrated, and the observation that the structural differences between the brain of the anthropoid apes and that of the lowest races of man are much less than those which we meet with in descending from the higher to the lower Simiæ, can no longer be shaken.

The weight and volume of the brain of the adult gorilla, the largest of the anthropoid apes, only slightly exceed those of the brain of the new-born (human) child. If only this circumstance be taken into consideration, other finer specific differences being left out of account, then we may have some warrant for saying, that the brain of the anthropoid apes only when fully grown attains that degree of development which the brain of the child possesses on its entrance into the world.

No doubt, however, the anthropoid type of brain structure is shown also in this, that in all the Simiæ, even the lowest, the cerebral hemispheres are sufficiently developed to overarch all the other parts, corpora quadrigemina and cerebellum, in such a manner that when the brain is seen from above these are completely covered.

The three higher organs of sense, eye, nose, and ear, are formed and situated exactly as in the human child. The eyes are placed near one another, separated only by a narrow nasal ridge, and are set in completely closed capsular orbits in the front of the face. The nose is flat as in the child, not prominent, the nostrils in some cases directed more sidewards than forwards, more so than even in the lowest races of man, but sometimes they are placed closer together. The ears in the anthropoid apes exactly resemble those of man, and in them too are similarly incapable of motion, while in the lower Simiæ they become somewhat more pointed and to a certain degree capable of being moved. The outer margin of the ear (the helix) is rolled in as in man, and only the inferior lobe is less developed and less clearly marked off.

The jaws and dentition demand a closer examination. Since these are in general more powerfully developed than in man, the maxillæ and gums are proportionally longer and narrower, more elliptical than circular in form, the lower jaw mostly higher than in man, but its two halves always, as in man, completely fused. I mention this character here expressly because it forms an essential distinction between the Simiæ and the Prosimii, in which latter the two halves of the lower jaw are connected in such a manner that they can easily be separated.

A projecting chin, what is called in more technical language a mental process, is altogether wanting in the Simiæ; but this feature even in human jaws, and especially in childhood, is often only slightly developed.

The premaxilla, which carries the upper incisors, becomes fused in man very early, even during embryonic existence, with the adjoining bones, while in the Simiæ, on the other hand, the fusion takes place later, mostly at the time of the emergence of the permanent molars.

If we now consider the dentition itself, the first thing that strikes us is that in all the Simiæ, but especially in males and in those genera which incline to the carnivorous type, the canines rise with their crowns above the masticating surface of the other teeth and fit into a more or less developed gap or diastema in the opposite set of teeth. All the other teeth lie close together with their crowns on the same level. In man large canines occur but seldom.

As already mentioned in the Introduction, the milk dentition demands special consideration, inasmuch as this represents the inheritance which the creature has derived from its ancestors.

With respect to the milk dentition the Simiæ are divided into two great groups. All the Old World Simiæ have twenty milk teeth, like man, namely, two incisors, one canine, and two premolars in each half of each jaw. All the New World forms, on the other hand, have twenty-four milk teeth, there being in them an additional premolar with the same incisors and canines. Through the development of the permanent dentition there arises a division among the New World forms, for while in all except the Clawed Monkeys, or Arctopitheci, three molars emerge in each half of each jaw, in these there are only two, the so-called wisdom-tooth, the last in the series, never appearing in them. We thus obtain the following dental formulas:—

MILK DENTITION.

	INCISORS.	CANINES.	PREMOLARS.	TOTAL.
Man and Old World Simiæ,	$\frac{2}{2}$	$\frac{1}{1}$	$\frac{2}{2}$	= 20
New World Simiæ,	$\frac{2}{2}$	$\frac{1}{1}$	$\frac{3}{3}$	= 24
Arctopitheci,	$\frac{2}{2}$	$\frac{1}{1}$	$\frac{3}{3}$	= 24

PERMANENT DENTITION.

	INCISORS.	CANINES.	PREMOLARS.	MOLARS.	TOTAL.
Man and Old World Simiæ,	$\frac{2}{2}$	$\frac{1}{1}$	$\frac{2}{2}$	$\frac{3}{3}$	= 32
New World Simiæ,	$\frac{2}{2}$	$\frac{1}{1}$	$\frac{3}{3}$	$\frac{3}{3}$	= 36
Arctopitheci,	$\frac{2}{2}$	$\frac{1}{1}$	$\frac{3}{3}$	$\frac{2}{2}$	= 32

Although, then, the Arctopitheci have exactly the same number of teeth as the Old World Simiæ and man, yet they belong to the general American type in that they differ from these, as all the other American forms do, in the number of their premolars.

The fundamental structure of the teeth is exactly the same as in man. The incisors are inserted somewhat obliquely as in the prognathous races of man, are broad and chisel-shaped, and have single roots. The canines are conical, sometimes curved and with sharp edges; the premolars with blunt tubercles; the molars four-sided, with at least four blunt tubercles separated by a transverse furrow, and sometimes in addition a fifth posterior unpaired tubercle. The differences are due to greater or less variations in the relative size of the individual teeth, as well as in the structure of the different parts; in particular to the exceptional development of the canines and the somewhat sharper cusps of the premolars in the baboons, to the more pointed form assumed by the molar tubercles in the Arctopitheci, which feed chiefly on insects. The range of these variations is, however, only very small, and one may say in general, that the dentition of the Simiæ, like that of man, exhibits a somewhat indifferent character, but is most closely allied to that of the tuberculate group of the Ungulata, more especially that of many fossil genera of this group, yet with indications of an approximation to the insectivorous type of dentition on the one side, and to that of the carnivores on the other.

With respect to the structure of the vertebral column, the chest, the shoulder-girdle, and the pelvis, we only observe, without desiring to go into too great detail, that a wide cleft can be shown to exist between the anthropoid apes, which nearly approach the human structure adapted for an upright position, and the other Simiæ, in which the arrangement of parts characteristic of four-footed mammals prevails, although with a gradual approach to the type of the anthropoid apes. The vertebral column shows only approximations to that double S-shaped curve, which is so characteristic of man, and which in an upright position distributes the weight of the body over a greater area. The chest in the terrestrial monkeys as in other four-footed mammals is laterally compressed, and the sternum projects to a certain extent in a wedge-form in the middle line; and only gradually is the broad flattened form of chest such as is seen in the anthropoid apes and in man developed. The shoulder-girdle is always composed of a broad scapula or shoulder-blade and a powerful collar-bone, such as is met with in all mammals in which the fore-limbs serve not only to support the body, but also to perform other functions, such as digging, flying, swimming, grasping, and so forth. The pelvis, which is narrow and placed parallel to the vertebral column in the lowest Simiæ, becomes gradually broader and more basin-shaped, and in the anthropoid apes closely approaches in structure the human pelvis, which, in consequence of the upright position, has to support the whole weight of the abdominal viscera.

We now turn to the limbs, which indeed are constructed entirely on the human type, but yet exhibit many differences. First of all it may be observed that the fore-limbs are in every case longer and more muscular relatively to the hind ones than in man, who has comparatively the strongest and longest legs of all animals, as is only natural when we consider that in him the upright position is normal, and the legs consequently have to bear the whole weight of the body. The relative proportions of the two pairs of limbs exhibit a gradual diminution in the amount of difference. From the monstrously long arms of the gibbons and the spider-monkeys a continuous process of shortening can be observed, especially in the anthropoid apes, until we come to man; yet even the arms of the gorilla, the ape that in this respect approaches most nearly to man, are still considerably longer than in the human species. The shorter legs of the Simiæ are less muscular; the thighs are flat, the buttocks angular, and there are no calves. But the number and relations of the bones are the same as in man, and moreover the Simiæ have the same power of pronation in the fore-arm as man, though not so highly developed.

The digits require a more thorough consideration. With the exception of the Arctopitheci the digits in all Simiæ have flat nails, which, however, in some species become more arched, and so pass into claws.

We are justified in saying that the Simiæ have four hands, while man has only two. In the former, as in all climbing animals, the hind-limbs are developed chiefly as grasping organs, in man only the fore-limbs. This essential difference goes so far that the Colobi in the Old World and the spider-monkeys (Ateles) in the New have no thumbs at all, accordingly no hands in the ordinary sense, and the Arctopitheci have indeed a thumb but not an opposable one.

All this is true enough, but when we go to the bottom of the matter, these seemingly far-reaching distinctions become shorn of much of their importance. In relation to function, indeed, they could not be greater than they are. In man the hind-limbs are only organs of support and locomotion, the fore-limbs solely of prehension and touch. In the Simiæ these functions separated in man are distributed among all the four limbs.

Nevertheless, except as regards the motions of hallux and pollex, the structure of the two extremities is the same in the Simiæ as in man. The hinder extremity of the former is a foot adapted for grasping indeed, yet entirely similar in its structure to the foot of man.

The human foot is distinguished from the hand chiefly by the shortness of the toes, the development of the heel and structure of the ankle generally, and the position of the foot with reference to the leg. The leg stands perpendicularly over the ankle, which has developed a posterior process, the heel. The hand is continuous in direction with the fore-arm, and has no heel; the articular surface which connects it with the arm is not found as in the foot on the back but at the end turned towards the body.

In all these respects the hind-foot in the Simiæ resembles the human foot. There is always a projecting heel, and therefore an ape's or monkey's foot can no more be brought into the same line with the leg than the human foot can; the two must always form an angle with one another.

The posterior "hand" of the Simiæ can never accordingly be compared anatomically with the human hand, but only with the human foot. Its ankle is identical in structure with that of a man, so much so that in the gorilla only very insignificant differences can be detected. The hand proper in the Simiæ, on the contrary, is constructed exactly like that of man, and even the absence of the thumb in many forms constitutes no essential difference.

And this nasty tail! Much paper would have remained unsoiled if the authors of certain controversial writings had known that the anthropoid apes have no tail, but on the contrary have a vertebral column terminating exactly as in man. But it would appear that in many circles it is impossible even to think of a monkey without a tail, and that involuntarily Cercopitheci and Semnopitheci are taken as the sole representatives of an order in which this appendage to the vertebral column undergoes all possible modifications, from the prehensile and tactile organ of the howling monkeys to the rudiment at the end of the vertebral column of the anthropoid apes.

With respect to internal organs only a few differences, and these not general, can be pointed out, such, for example, as cheek-pouches, bladder or drum-like organs for increasing the loudness of the voice, the constricted stomach in the Semnopitheci, and similar peculiarities which are not of much account. The human type is prominent everywhere, and quite peculiarly so in what belongs to the reproductive organs. The Simiæ never have more than two pectoral mammæ; the envelopes of the ovum are exactly of the same nature as in man, and the placenta, like the human one, is discoidal, in many cases simple, but in others divided by a fissure into two lobes.

All the anatomical facts may accordingly be summed up thus, that the characters which distinguish the Simiæ from man may indeed be regarded as sufficient to found a separate order, but that that is the utmost value they have. The simian characters considered as a whole present a curious mixture, inasmuch as some of them correspond to those of the human child and remain at this stage, while others show a development of certain peculiarities beyond the point arrived at in man. The head of a male gorilla with its enormous teeth, muscle-tendons, and ridges, on the one hand, and the child's brain within it, on the other hand, affords the best illustration of this assertion.

All the Simiæ are originally arboreal, and many of them never come to the ground in a state of freedom. In climbing they are extremely adroit and powerful, the most expert gymnasts, accomplishing the most astonishing leaps with safety and rapidity. But some come to the ground occasionally, others prefer to spend a part of their life there, and others again scarcely ever leave the ground, but climb about among the rocks in the mountains. These particulars are so far interesting in that they represent a gradual transition to the erect attitude of man. Except the anthropoid apes all the Simiæ set the soles of their hind-feet flat upon the ground in walking, and most of them also those of the fore-feet. On the other hand, the long-armed spider-monkeys (Ateles), when they do walk at all, which is quite the exception, turn the hands in in such a manner that the edge corresponding to the little finger touches the ground. The anthropoid apes place their hind-feet on the ground in an exactly similar manner, while they fold up their hands so as to support themselves on their knuckles. The members of the genus Troglodytes (the chimpanzee and the gorilla), however, frequently walk long distances upright, placing the hind-feet flat on the ground, and it is known regarding the gorilla that in so doing he always keeps his arms free for fighting. The very long-armed gibbons, in the rare instances in which they come to the ground, walk upright, rocking from side to side, while they hold up their long arms in the air so as to balance themselves. The upright position, always, however, with a bent back, can thus be assumed by the anthropoid apes, but not for very long distances, and in connection with that it is a noteworthy fact that they give their hands and feet that position which is seen in a new-born child—the fingers bent in and the soles of the feet turned in so that the outer edge would touch the ground.

The food of the Simiæ is very varied, but for the most part mixed. Only very few of them are pure vegetable feeders, these living chiefly on fruits or even juicy leaves. Most of them require a larger or smaller addition of animal food—Articulata and their larvæ, the larger species even eating reptiles, birds, and small mammals. Some, such as the Arctopitheci, appear to be wholly insect-eaters. In keeping these animals in captivity far too little attention has been paid to this circumstance.

Still more manifold are their mode of life, habits, temperament, and mental capacities. Most species live in societies, often indeed in large troops and herds subject to one of the older animals as a leader; some, such as the large anthropoid apes, have been met with only in small families—male, female, and child. Most of the Simiæ of the Old World are highly intelligent, extremely curious, given to all sorts of tricks, and like children liable to pass with extreme rapidity from a cheerful to a dull or angry mood; while the American forms, on the other hand, seem as a rule more given to brooding, and are less sensitive and slower in their movements. Even in early years, for it is only young specimens on which it has been possible so far to make continued observations in Europe, the anthropoid apes exhibit a certain dignity in their bearing, while the baboons are intractable, sullen, and mostly ill-natured creatures. But here also, as in the case of children, to whose general behaviour that of the apes has at least some resemblance, great individual differences in capacity and temperament are observable, so that the accounts of the behaviour of individuals of the same species are often diametrically opposite, one observer describing a species as ill-natured and having vices of all kinds, while another finds it amiable and good-natured. And further, in reading all these accounts we must take into consideration the fact that most of the observations have been made on captive specimens, which in consequence of training, constant teasing, and deprivation of their freedom, find themselves in altogether abnormal states of mind and feeling, states which often diverge greatly from those manifested when they are living in freedom.

This circumstance also is specially worthy of note, that as in the bodily so also in the mental development of the apes the period of sexual maturity forms an important crisis. It is only at this period that those changes take place which lead to the characteristic formation of jaws and teeth, and of the strong muscle tendons and crests on the skull, and with the appearance of these external features is connected in the most intimate manner the development of the evil instincts, savageness, lasciviousness, and so forth, while at the same time the intellectual qualities remain at the same stage which they had hitherto reached. From this period the appetite for food and the sexual instinct govern the animal almost exclusively. Similar conditions manifest themselves in the lower races of man, though not in so pronounced a manner.

(A) THE MONKEYS OF THE OLD WORLD

(CATARRHINÆ).

With 32 teeth, and narrow septum between the nostrils, which are directed somewhat forwards.

ANTHROPOID APES

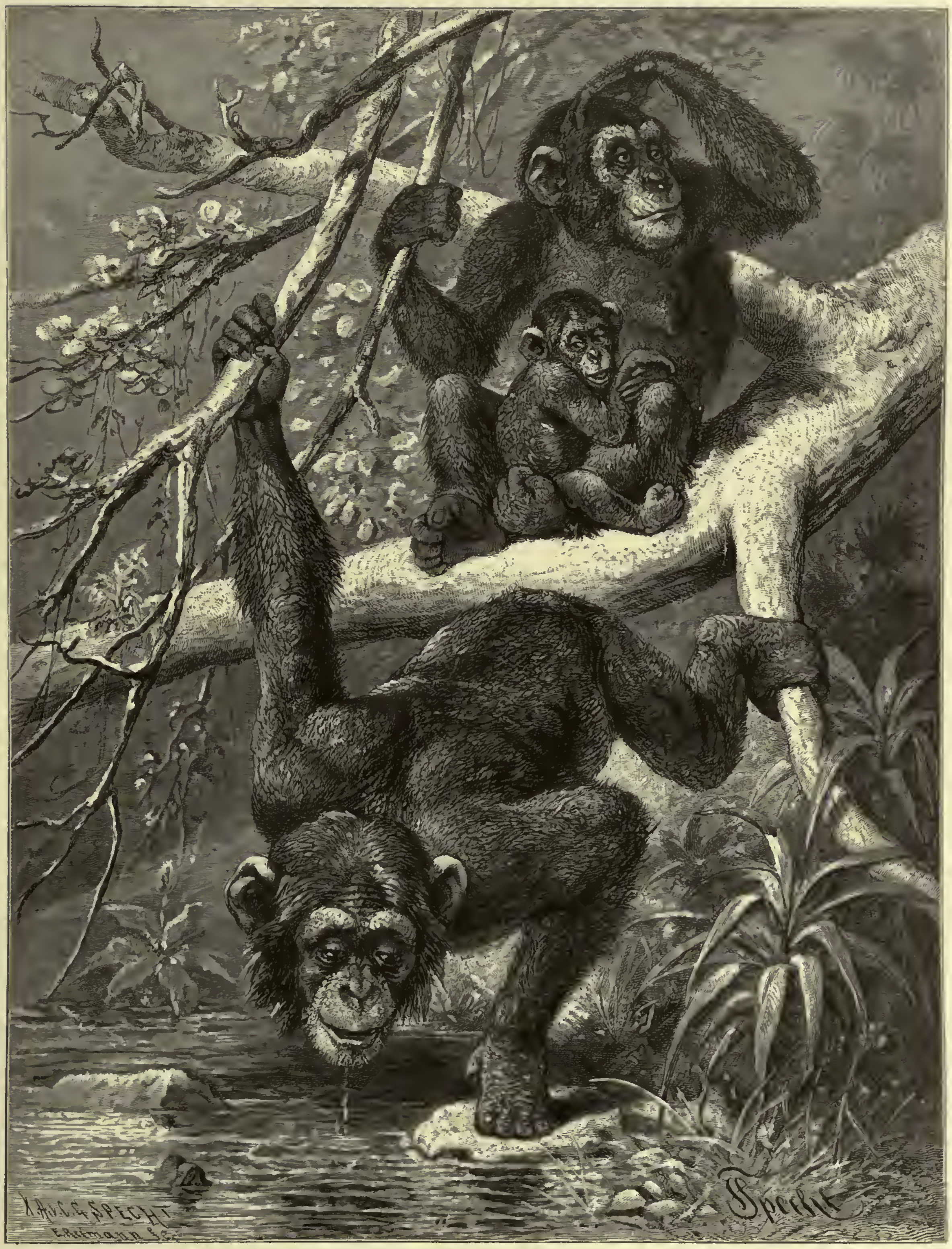
(ANTHROPOMORPHÆ).

Tailless, with naked face somewhat resembling that of man; body covered with long hairs.

Black Anthropoid Apes (*Troglodytes*).

With fore-limbs reaching no further than the ankles, and thirteen pairs of ribs; natives of Africa.

As early as the year 500 B.C. Hanno, the Carthaginian admiral, who then sailed along the west coast of Africa to beyond Sierra Leone at the head of a fleet of sixty vessels, became acquainted with large black anthropoid apes. Three females were killed and their skins brought to Carthage. The interpreters he said, called these apes "Gorillas," a name no longer met with in the negro dialects. Later on people became better acquainted with these apes through the settlements formed on the Guinea coast, and as far back as two hundred years ago living specimens of the young were brought to Europe. But it was not till 1846 or 1847 that it was definitely ascertained that two species of these apes could be distinguished, a smaller species now known as the chimpanzee, and a larger to which the name of gorilla is now restricted; and while it was formerly believed that only the coast regions were inhabited by these animals, the accounts brought by the more recent explorers of Central Africa seem to leave no doubt regarding the fact that the


X.A.v.C.G.SPECHT
E.Heumann Sc.
Specht

To face page 32.

PLATE I. — THE CHIMPANZEE (*Troglodytes niger*).

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

whole of the interior of the Dark Continent is occupied by large apes of this description. Whether a third species, the chego, must be admitted or not is still doubtful. The individual differences among these apes are often very considerable, and hybrids are certainly not impossible, in fact according to the accounts of hunters are even frequent.

It is a very difficult matter to obtain reliable information concerning the distribution, specific characters, habits, and mode of life of these remarkable apes, which unquestionably approach nearest to man in their organization. If even white hunters are notorious for their magniloquent exaggerations, and the hunting tales of Europe are held in light esteem as regards the matter of truth, this is much more the case with negroes and many travellers. Competent trustworthy observers have made the acquaintance of these animals only in the young state, and in addition to that only in captivity. All the anthropoid apes brought to Europe have died in childhood. In no case can we be sure that the creature had attained the eighth year of its age. Like the bodily structure so also must the qualities of the animals alter considerably in the adult; but of the adults we know nothing but the dead bodies, together with a number of stories distorted by all sorts of fables. In fact there is only a single white man who has boasted of having himself killed an ape of this kind, and he has been convicted of so much exaggeration and indulgence in the fabulous that his whole narrative has come to be looked upon as very improbable.

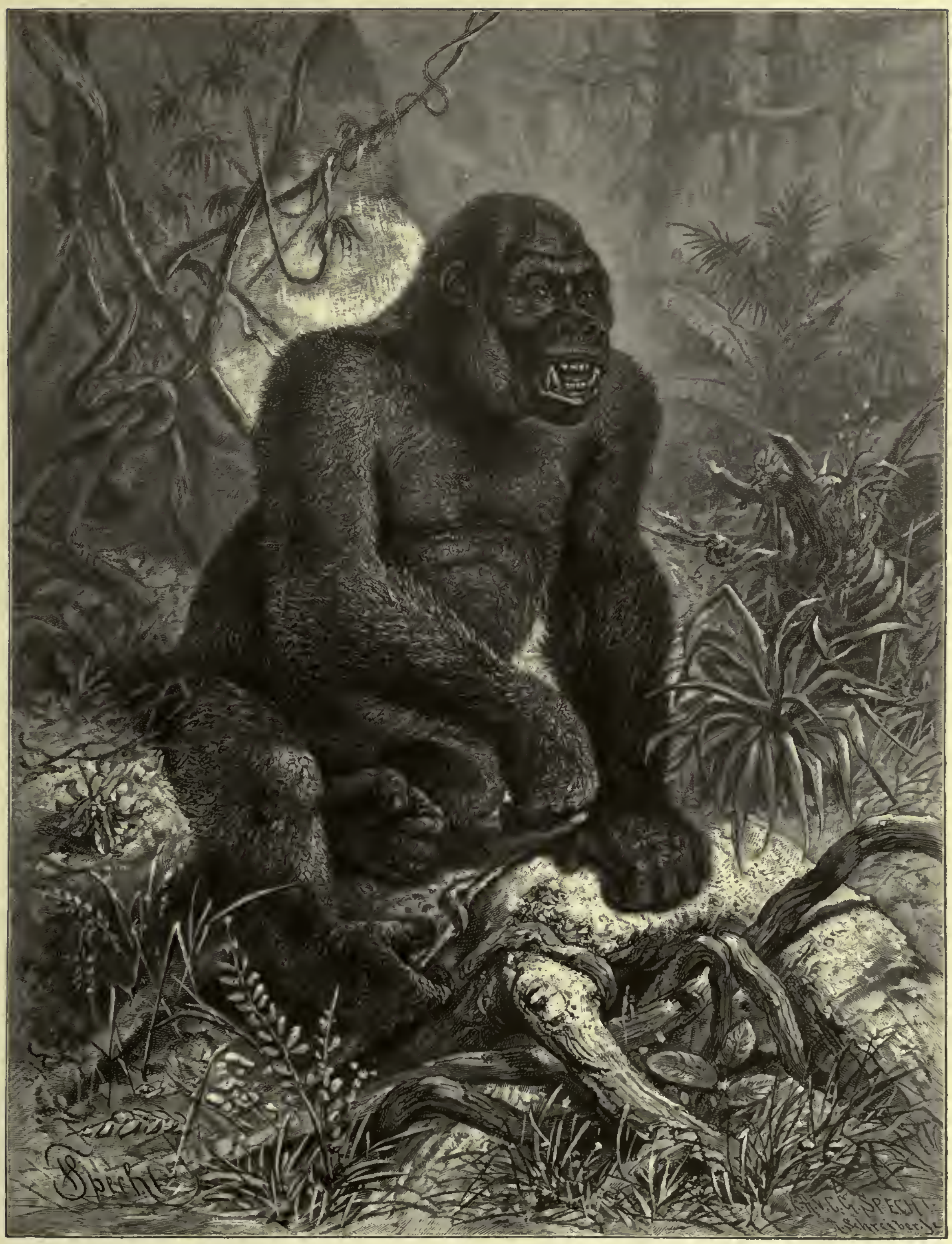
In the full-page illustration (Plate I.) the **Chimpanzee** (*Troglodytes niger*) is represented in a pleasant homely family group. The papa clings with his right hand and left foot to shoots from a dependent branch, the mamma sits on the outlook with her little one on her lap. Papa is quenching his thirst, and in doing so rests upon his left hand, which is bent into the position which the habit of walking on all-fours has caused the creature to adopt. The bristly hair of the head, long behind, and the short white beard leave the characteristic features of the old male, the very prominent orbits in which the eyes are deeply sunk, and the longitudinal crest on the skull (the sagittal crest), plainly recognizable; traits which in the female and the young are not well developed. The large ears spread far out from the head; the nose is broad and flattened, the lower part of the face projecting and muzzle-like. The large lower lip is specially characteristic in the chimpanzee, who uses it as a pouch, while either alone or in conjunction with the upper lip it bears a most important part in the play of feature with which the creature expresses its feelings. The naked parts of the face along with the ears are of a dirty flesh-colour inclining to brown, the region of the eyes and the bridge of the nose almost black, the edges of the lips flesh-coloured, the naked hands and feet of a rather dirty-looking black, the long thin fur, which on the back of the head is developed into a kind of tuft, and on the sides of the face forms bristly whiskers, quite black. On the fore-arms the hair, as in all anthropoid apes, is directed towards the elbow; the tufts of white hair on the buttocks are not seen in our drawing. Hands and feet are quite human in their character; only on the hands the thumb is weaker, while the great toe is stronger than in man, and the latter lies apart from the rest of the toes, causing the foot to be relatively broader than the human foot in front. The female, and still more the young animal, are distinguished from the adult male by the rounder form of the head, which more resembles that of man in shape, but even in the infant chimpanzee the muzzle projects much further than in the lowest human races. Old males of the chimpanzee attain a height of nearly five feet, but compared with man have a greater breadth across the shoulders and more powerfully developed muscles in the long fore-arms, which, when the creature stands upright, nearly reach the ankles, while the legs are shorter and less fleshy than in man, the muscles of the buttocks and the calves of the legs in particular being very poorly developed.

Of the life of these creatures in a state of freedom we know very little. In the Guinea country the chimpanzee prefers the dry somewhat open woods, with patches of grass-land here and there, to the dense primeval forest which he inhabits in the interior of the continent. There families, consisting of father, mother, and child, roam about in search of their food, which consists of fruits, juicy leaves, and roots. Sometimes the families unite in troops, among which it is said a good deal of merriment prevails, the members of the troops amusing themselves with games and wrestling, screaming, drumming on hollow trees, and feasting on fruits. Beyond doubt young birds and small mammals are also eaten at these festivals; but all young chimpanzees, which have been kept in great numbers in Europe, exhibit a truly amusing dread of lizards, and still more of serpents.

All observers are agreed upon this, that the chimpanzee builds for itself a very simple nest or rather seat in the fork of branches in high trees, employing for the purpose small branches and withered foliage. Sometimes these seats or nests are even provided with roofs as a protection against the rain. On these he spends the night, and there the female lies after having given birth to her young. All are agreed further that the creature displays great dexterity in climbing, and that he flees before the face of man; but when attacked, or when called upon to defend his young, towards which he shows the tenderest attachment, uses his teeth and his arms vigorously. In such an encounter his well-developed canines, and the length and strength of his arms, with which he hugs his antagonist in his embraces, stand him in good stead. He will even on occasion lay about him with spears wrested from his pursuers. At other times he is on the whole a good-humoured creature, who but seldom makes himself guilty of doing damage to fruit-plantations, though bananas in particular are a strong temptation to him. Since the changes in his dentition are completed only in the sixth year, we may estimate the length of his life at about equal to that of man.

Our actual knowledge of the life of this ape in a state of freedom may be said to be confined to the particulars just given. The young have been observed only in captivity.

Putting aside all individual differences, which, it should be remembered, may be partly due to the treatment and training to which different specimens have been subjected, we find that all the observations which have been made on probably more than a hundred young chimpanzees which have been brought captive to Europe, combine to show that they are very excitable, sanguine, intelligent creatures, whose qualities of mind and temperament can scarcely be distinguished from those of similarly endowed children of the human species. Satisfaction, joy, which is manifested even by smiling, depression, pain, despair, anger, and fury succeed one another suddenly, like rain and sunshine, and the great vivacity of their temperament is shown in their almost unceasing occupation with toys and gymnastic apparatus, in their attentive observation of their surroundings, and of all that goes on about them. To all who show themselves to be of a kindly and sympathetic nature they exhibit the most touching and devoted attachment, and their amiability in playing with children is another conspicuous feature of their disposition. Easy and rapid apprehension, careful observation, and the power of drawing logical conclusions are qualities that cannot be denied to him. Like the child the young chimpanzee knows instantly whether the visitor whom he sees for the first time is kindly disposed to him or not. I have myself observed a case in which a chimpanzee, who had got himself a little scratched


Specht
G. SPECHT
Schreiber

To face page 34.

PLATE II. — THE GORILLA (*Troglodytes gorilla*).

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

by the point of a slightly projecting nail in the wall of his cage, first carefully examined the part, then sought to remove the projecting point, and afterwards, when he was let out, immediately proceeded to search for the head of the nail on the outside of the wall, and then on finding it began to use his teeth and fingers in making efforts to pull out the nail. Ultimately this was done for him with a pair of pincers, whereupon he broke out into lively demonstrations of joy. "He died like a human being, not like a beast," said the physician who attended the chimpanzee in the garden at Hamburg during its last illness.

On the ground of very slight differences, which may easily be only individual variations, French anatomists had distinguished a second species of black African anthropoid apes, the **Chego** (*Troglodytes Tchego*). To this species was assigned a female of only five or six years old, purchased for the Dresden Zoological Gardens in 1873 and kept there till her death, under the name of **Mafoka.** This individual may have been a hybrid between a **gorilla** and a **chimpanzee.** Of the **chimpanzee** it had the large standing-out ears, the lips and the muzzle, and the narrow hands and feet; of the **gorilla**, the savage appearance due to the very prominent eyebrows and the broad nose, together with the powerful arms; the legs, perhaps, were somewhat longer and more powerful than in the other two species. The animal had been captured in South Guinea. In its behaviour it was in no way different from a chimpanzee.

The largest and most powerful of the anthropoid apes is the **Gorilla** (*Troglodytes gorilla*), which in the upright position may attain a height of 5 feet 3 inches, and when sitting appears larger than a human being since its legs are shorter. The body is in fact stronger, the shoulders are broader, the arms shorter than in allied anthropoid apes, the arms reaching only to about the knees. The changes which the animal, especially the male, undergoes with years are extraordinary. The young gorilla, of which a specimen was brought to Europe by Dr. Falkenstein, so far the most important and indeed almost the sole result of the German expedition under Güssfeld, has a roundish head with a pretty well arched brow, prominent orbits, flat nose, large muzzle, very small human-like ears, powerful breast and limbs, and a fat projecting paunch. The thick skin everywhere gathers into broad folds, even on the forehead, so that the expression of the face is somewhat like that of an old meditative negro. In the male much more than in the female, as is excellently shown in Plate II., the jaws and the ridges above the eyes are developed in a fearful manner. A high sagittal crest, which gives to the crown and back of the head in the living animal the form of the ridge of a house-roof, runs along the whole length of the skull; and from it highly prominent lateral ridges run on each side towards the ears. The orbits become enormously thick and large, so that the rather small eyes lie deeply sunk in their cavities. The jaws are very prominent, and when opened to the very slightest extent allow us to see the large conical canines which rise far above the summits of the other teeth. The snout is not so round and muzzle-like as in the case of the chimpanzee; the lips, and especially the under lip, not so extensible as in the latter, in which it takes the place of a cheek-pouch. The nape of the neck of the adult gorilla is a genuine bull-neck, the breast is rounded, the belly, though not so plump as in the young, is at least of considerable size. The limbs are extremely muscular, the hands and feet most like the corresponding parts in man. The hand is broad, the fingers in about the same proportions as those of man, the fore and middle finger united by skin to the first joint. With the exception of the thumb, which is feebly developed, the hand looks like the widely spread out hand of a smith. The foot is broad, not so much contracted and arched at the instep as that of the white man, but more like the flat foot of the negro; the toes are short and broad, although somewhat longer than those of man; the great toe is strong and capable of being moved considerably apart from, and of being opposed to the other toes. In this and in the weak thumb lie the chief differences of the extremities of the gorilla as compared with those of the human species. The front part of the face is naked, the skin, like that of the hands and feet, being blackish; the body is covered with coarse hairs, which on the cheeks form slight whiskers, and on the nape of the neck a moderately large tuft. The young have quite black hair; the fur of the adult becomes matted, and in colour brownish-black even sprinkled with gray. The upward direction of the hair of the fore-arm is very marked.

The gorilla lives a retired life with wife and child in the thickest forests of the west coast of Africa near the Gaboon river. Usually it walks on all-fours, delights in climbing trees, which it does with great facility, and on the trees constructs resting-places for itself with twigs and leaves. It lives on fruits, leaves, and a peculiar kind of grass growing amidst brushwood. Its usual cry is plaintive, but its cry of rage resembles the growl of a tiger.

Beyond doubt this animal, so strong and so formidably armed, must be a highly dangerous antagonist in a fury, an antagonist able to withstand any ravager of the wilderness, and accordingly also man. But the history of the gorilla is interwoven with so many fables that it is difficult to unravel the truth. The stories which negroes and some white men have told of him are in a great measure hunting tales. So much we seem to be able to gather from them, that the gorilla for the most part does not trouble himself about man unless he is suddenly and unawares alarmed and attacked. The female then uniformly takes to flight with her young one, but the male prepares for defence, rushes bellowing on all-fours upon his antagonist, on approaching whom he stands up like a bear and tries to strike him down with his hands, and to tear him to pieces with his teeth. The sport is no doubt a highly dangerous one, but yet probably less dangerous than hunting the lion or the tiger. Savage enough the creature seems, and naturally inspires terror in proportion.

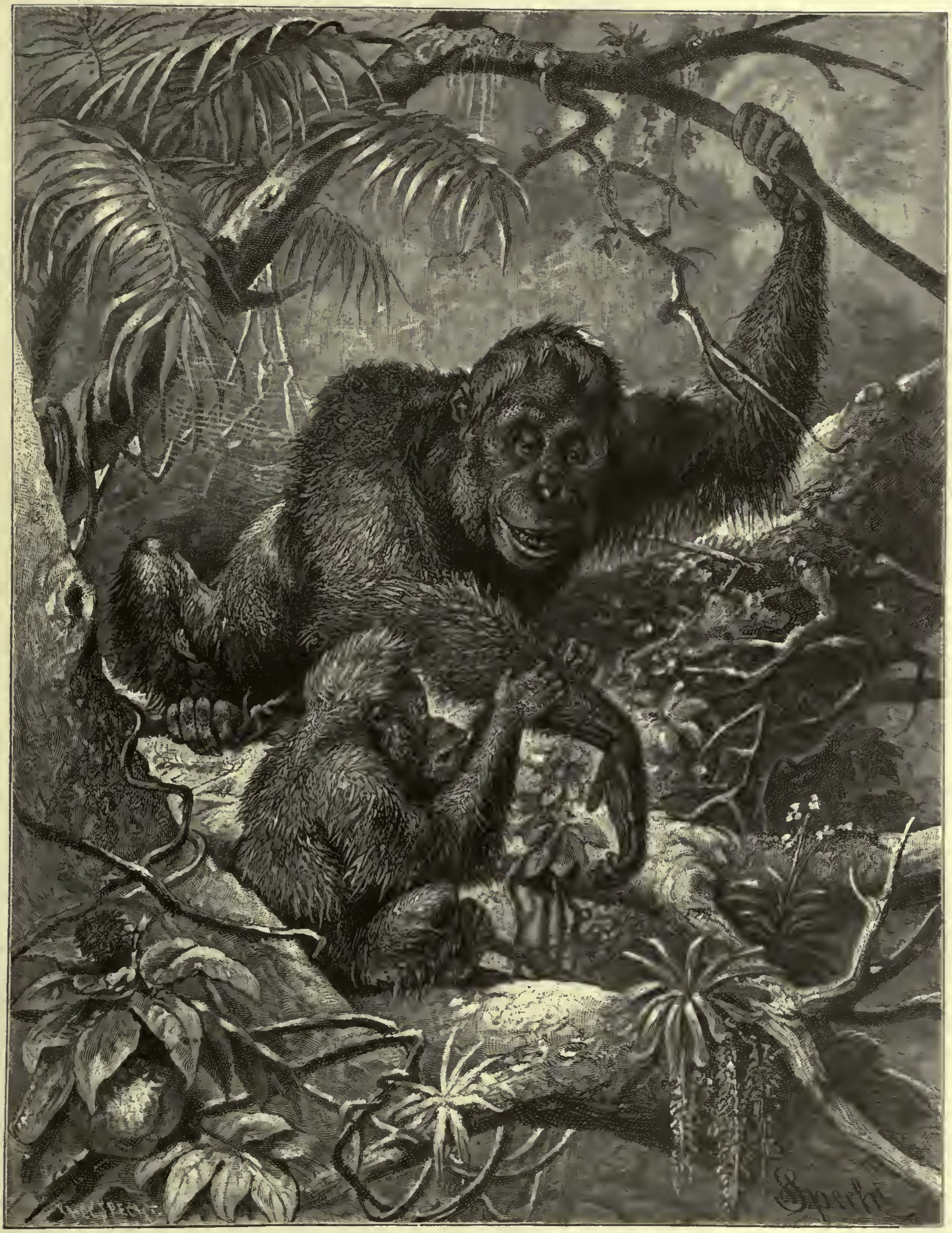
The young gorilla that lived for some time in the Berlin aquarium was a very good-humoured, but quiet and grave-looking creature, and in its calm and composed demeanour presented a strong contrast to a much more lively chimpanzee, which often vainly sought to engage it in play. Reade, who kept a young gorilla in its native land, describes it as being quite as sensible and docile as chimpanzees of the same age. In place of the cheerful and even noisy disposition of the chimpanzee we have in the case of the gorilla a quieter and graver temperament.

Red Anthropoid Apes (*Simia*).

With very long arms, and twelve pairs of ribs; natives of the East Indies.

In the depths of the marshy forests and jungles of the island of Borneo, more rarely on Sumatra, there is found an anthropoid ape, which attains a height of 4 feet 7 inches at the most, and is usually called **Orang-utang**, though by the natives **Mias** (*Simia satyrus*), Plate III. Many naturalists have admitted several species; the distinctions which they pointed out, however, seem to be more of an individual or sexual character. As in all apes the ridges above the eyes and the crests of the skull, as well as the jaws, are in these also only gradually developed with years and more particularly in the male sex.

As the extraordinary length of the arms



To face page 36.

PLATE III. — THE ORANG-UTANG OR MIAS (*Simia satyrus*).

UNIVERSITY
OF
CALIFORNIA

in itself indicates (a mias of 4 feet 5 inches spanned with outstretched arms and hands a length of 7 feet 10½ inches), this ape is an arboreal climber in a much greater measure than his African kindred, and in this respect, as in many other anatomical characters, resembles the gibbons, which like him belong to the East Indies. The skull in the young and the female is round, but at the same time furnished with powerful jaws, which even in the young protrude much more than in the African apes, and with their covering of thin but wide lips have almost the appearance of a kettle-drum seen from below. The orbital and cranial ridges even in old males are less prominent than in the chimpanzee, and still less so than in the gorilla. On the other hand two half-moonshaped projecting cheek-swellings (absent in the female) give to the adult male a very hideous aspect, reminding one of the baboons, and this hideousness is intensified by the fact that the creature has a pouch in the throat capable of being dilated with air at pleasure, and when so dilated resembling a crop. The arms, which are thin, especially the lower parts, and covered with long bristly hairs, are so long that when the creature stands upright with bent fingers the knuckles touch the ground. The hands have rather long fingers and the feet long toes, and both are narrow. The thumb is pretty strong. The wrist has one bone more than in man. The abdomen is thick and protruding; the legs are short and thin. The face, hands, and feet are naked, slate-gray in colour, the long hair of a dark rusty red, but brighter in the young. In old males the canines are extremely prominent.

The adult orang-utang, when he has set himself to rights on a tree with his young one, which in Plate III. is represented as doing the kindly office of hunting for insects on his parent, is described in the most trustworthy accounts of travellers as a good-humoured and well-disposed creature, generally to be seen swinging itself by means of its long arms with much deliberation from branch to branch, and after careful trial from tree to tree, descending to the ground only when forced to do so by the most urgent need of water. It breaks off twigs and small branches to make sleeping-places for itself on high trees, and is said to employ large leaves to protect itself against rain. It lives chiefly on fruits, which it opens with great dexterity. According to the reports of the natives the orang has to fight against only crocodiles and large serpents, and these contests mostly end in leaving it victorious. It does not fear man, but when attacked defends itself courageously with hands and teeth. An orang, which had got its arm smashed by a shot, climbed up a high tree with great agility, and with its uninjured arm broke off a number of branches with their leaves on, with which it quickly made a scaffolding on which it screened itself completely from the eyes of its pursuers. An infant orang, still without teeth, which Wallace found on the breast of its mother, who had been killed, was quite as helpless as a human child would have been, eagerly clutched him in order to suck, and cried like a child when it had dirtied itself. At the end of a month it cut its first two incisors, and made its first attempts at walking. Young specimens of this ape have often been brought to Europe and tamed. They are easily trained to cleanliness, are obedient, grave-looking, almost melancholy (partly perhaps in consequence of the cold), cover themselves up in bed, climb with great facility, are quite as expert in gymnastic exercises as their African cousins and as much afraid of reptiles, are fond of intoxicating drinks, extremely attached to their keepers, but far less attentive and less easily excited than the African apes. That they are not wanting in reflection is shown by the well vouched-for case in which an ape of this kind, after it had seen the lock of its chain opened with a key, carefully examined the lock and tried to open it by means of a piece of wood which it turned about in all directions in the keyhole. As against that of the highly excitable, always active chimpanzee, ever inclined to fun and frolic, the school-certificate of the orang would run something like this: A quiet reflective child, serious and meditative, even tedious.

The particulars regarding the young mias referred to above as having been captured by Wallace will be read with interest. A female mias having been shot, the young one was found close by "face downwards in the bog. This little creature was only about a foot long, and had evidently been hanging to its mother when she first fell. Luckily it did not appear to have been wounded, and after we had cleaned the mud out of its mouth it began to cry out, and seemed quite strong and active. While carrying it home it got its hands in my beard and grasped so tightly that I had great difficulty in getting free, for the fingers are habitually bent inwards at the last joint so as to form complete hooks. At this time it had not a single tooth, but a few days afterwards it cut its two lower front teeth. Unfortunately I had no milk to give it, as neither Malays, Chinese, nor Dyaks ever use the article, and I in vain inquired for any female animal that could suckle my little infant. I was therefore obliged to give it rice-water from a bottle with a quill in the cork, which after a few trials it learned to suck very well. This was very meagre diet, and the little creature did not thrive well on it, although I added sugar and cocoa-nut milk occasionally to make it more nourishing. When I put my finger in its mouth it sucked with great vigour, drawing in its cheeks with all its might in the vain effort to extract some milk, and only after persevering a long time would it give up in disgust, and set up a scream very like that of a baby in similar circumstances.

When handled or nursed it was very quiet and contented, but when laid down by itself would invariably cry; and for the first few nights was very restless and noisy. I fitted up a little box for a cradle, with a soft mat for it to lie upon, which was changed and washed every day; and I soon found it necessary to wash the little mias as well. After I had done so a few times it came to like the operation, and as soon as it was dirty would begin crying, and not leave off till I took it out and carried it to the spout, when it immediately became quiet, although it would wince a little at the first rush of the cold water, and make ridiculously wry faces while the stream was running over its head. It enjoyed the wiping and rubbing dry amazingly, and when I brushed its hair seemed to be perfectly happy, lying quite still with its arms and legs stretched out while I thoroughly brushed the long hair of its back and arms. For the first few days it clung desperately with all four hands to whatever it could lay hold of, and I had to be careful to keep my beard out of its way, as its fingers clutched hold of hair more tenaciously than anything else, and it was impossible to free myself without assistance. When restless, it would struggle about with its hands up in the air trying to find something to take hold of, and, when it had got a bit of stick or rag in two or three of its hands, seemed quite happy. . . . Finding it so fond of hair I endeavoured to make an artificial mother, by wrapping up a piece of buffalo-skin into a bundle, and suspending it about a foot from the floor. At first this seemed to suit it admirably, as it could sprawl its legs about and always find some hair, which it grasped with the greatest tenacity. I was now in hopes that I had made the little orphan quite happy; and so it seemed for some time, till it began to remember its lost parent, and try to suck. It would pull itself up close to the skin, and try about everywhere for a likely place; but, as it only succeeded in getting mouthfuls of hair and wool, it would be greatly disgusted, and scream violently, and, after two or three attempts, let go altogether. One day it got some wool into its throat and I thought it would have choked, but after much gasping it recovered, and I was obliged to take the imitation mother to pieces again, and give up this last attempt to exercise the little creature.

After the first week I found I could feed it better with a spoon, and give it a little more varied and more solid food. Well-soaked biscuit mixed with a little egg and sugar, and sometimes sweet potatoes, were readily eaten; and it was a never-failing amusement to observe the curious changes of countenance by which it would express its approval or dislike of what was given to it. The poor little thing would lick its lips, draw in its cheeks, and turn up its eyes with an expression of the most supreme satisfaction when it had a mouthful particularly to its taste. On the other hand, when its food was not sufficiently sweet or palatable, it would turn the mouthful about with its tongue for a moment as if trying to extract what flavour there was, and then push it all out between its lips.

If the same food was continued, it would set up a scream and kick about violently, exactly like a baby in a passion.

After I had had the little mias about three weeks, I fortunately obtained a young hare-lip monkey (*Macacus cynomolgus*), which, though small, was very active, and could feed itself. I placed it in the same box with the mias, and they immediately became excellent friends, neither exhibiting the least fear of the other. The little monkey would sit upon the other's stomach, or even on its face, without the least regard to its feelings. While I was feeding the mias the monkey would sit by, picking up all that was spilt, and occasionally putting out its hands to intercept the spoon; and as soon as I had finished would pick off what was left sticking to the mias' lips, and then pull open its mouth and see if any still remained inside; afterwards lying down on the poor creature's stomach as on a comfortable cushion. The little helpless mias would submit to all these insults with the most exemplary patience, only too glad to have something warm near it, which it could clasp affectionately in its arms. It sometimes, however, had its revenge; for when the monkey wanted to go away, the mias would hold on as long as it could by the loose skin of its back or head, or by its tail, and it was only after many vigorous jumps that the monkey could make his escape.

It was curious to observe the different actions of these two animals, which could not have differed much in age. The mias, like a very young baby, lying on its back quite helpless, rolling lazily from side to side, stretching out all four hands into the air, wishing to grasp something, but hardly able to guide its fingers to any definite object; and when dissatisfied, opening wide its almost toothless mouth, and expressing its wants by a most infantine scream. The little monkey, on the other hand, in constant motion; running and jumping about wherever it pleased, examining everything around it, seizing hold of the smallest objects with the greatest precision, balancing itself on the edge of the box or running up a post, and helping itself to anything eatable that came in its way. There could hardly be a greater contrast, and the baby mias looked more baby-like by the comparison.

When I had had it about a month, it began to exhibit some signs of learning to run alone. When laid upon the floor it would push itself along by its legs, or roll itself over, and thus make an unwieldy progression. When lying in the box it would lift itself up to the edge into almost an erect position, and once or twice succeeded in tumbling out. When left dirty, or hungry, or otherwise neglected, it would scream violently till attended to, varied by a kind of coughing or pumping noise, very similar to that which is made by the adult animal. If no one was in the house, or its cries were not attended to, it would be quiet after a little while, but the moment it heard a footstep would begin again harder than ever.

After five weeks it cut its two upper front teeth, but in all this time it had not grown the least bit, remaining both in size and weight the same as when I first procured it. This was no doubt owing to the want of milk or other equally nourishing food. Rice-water, rice, and biscuits were but a poor substitute, and the expressed milk of the cocoa-nut which I sometimes gave it did not quite agree with its stomach. To this I imputed an attack of diarrhœa, from which the poor little creature suffered greatly, but a small dose of castor-oil operated well, and cured it. A week or two afterwards it was again taken ill, and this time more seriously. The symptoms were exactly those of intermittent fever, accompanied by watery swellings on the feet and head. It lost all appetite for its food, and, after lingering for a week a most pitiable object, died, after being in my possession nearly three months. I much regretted the loss of my little pet, which I had at one time looked forward to bringing up to years of maturity, and taking home to England. For several months it had afforded me daily amusement by its curious ways, and the inimitably ludicrous expression of its little countenance. Its weight was three pounds nine ounces, its height fourteen inches, and the spread of its arms twenty-three inches."—Wallace, *Malay Archipelago*, chap. iv.

Gibbons (*Hylobates*).

Tailless Asiatic arboreal apes, with extraordinarily long arms and hands, and small naked spots on the buttocks.

These are the dwarfs among the anthropoid apes, for they never exceed 3 feet 3 inches in height. The arms are so long that even in the upright position they must be bent at the elbows in order that the wrists may touch the ground.

The round well-formed head, the face with the small rounded human-like ears, orbits and jaws scarcely at all protruding, and the but slightly flattened nose, the rounded breast, as well as the internal structure of the head and the skeleton of the body, would cause these apes to resemble man more closely than any others, were it not for the greatly contracted abdomen, the long pointed canines in the upper jaw, the monstrously long arms, hands, and feet, the dense woolly covering of hair, and the naked patches on the buttocks answering to the ischial callosities of other monkeys. This last feature is, however, not very conspicuous, inasmuch as the patches are often hidden by the surrounding hair. Even the brain is much less rich in folds and convolutions, and resembles that of the Semnopitheci rather than the complicated brain of the large anthropoid apes.

The presence of a pouch in the throat in both sexes, of distinct though less noticeable cheek-swellings in the old males, the structure of the limbs, and the existence of a supernumerary bone in the wrist, are all characters in which this creature approaches the mias; only one might say that the arms are lengthened to the extent of caricature. They are so long that the gibbons but seldom make use of them in walking on the ground, which indeed they touch only on exceptional occasions when living in freedom. They then waddle along upright with their great toes widely spread out, with uplifted arms stretched out sidewards as a balancing rod, the long hands hanging down like goosewing-dusters, the head hanging a little forwards, and the back bent like a fiddle-bow.

On the trees of the lower forests of the Great Sunda Islands and the neighbouring mainland as far as Assam and Southern China, and on the island of Hainan, dwell the seven species of this genus, which are indeed mostly distinguished by only very unimportant differences. The only exception in this respect is the largest species, the **Siamang** (*Hylobates syndactylus*), which is found only on Sumatra and the Malay Peninsula, and has the second and third toes of the hind-feet united.

All observers are unanimous in admiring the facility, agility, and security with which these apes, which mostly live socially in troops of thirty or more, move about in their primeval forests. They appear rather to fly than to leap. In the act of leaping they can alter the direction in which they are moving. The smallest twig serves as something to catch hold of with their long arms or to rest on with their powerful feet, in order to give themselves a new impetus for darting across intervals of thirteen or fourteen yards. Captive specimens have been known to catch fruits thrown to them while darting through the air, without being thereby prevented from reaching their goal. Gibbons are to be found only in low-lying regions, for in spite of the frequently dense woolly fur with which they are covered, they are extremely sensitive to cold. They feed chiefly on juicy leaves, but, as observations on captive specimens show, do not despise insects and eggs, a diet in which probably we may read the significance of the large canines. A tamed hoolock ate most eagerly of rice and bananas, and drank coffee, tea, and milk, usually merely licking its hand after dipping it into the liquid, as we see one of the white-handed gibbons doing in the illustration on p 43, though when very thirsty it would drink out of the cup. But besides the articles of food mentioned it would also take eggs or the wing of a fowl from a plate, and sought for spiders, and showed great dexterity in catching flies with its right hand, eating them when caught.

With one exception all observers who have seen gibbons in a state of nature or in captivity describe them as good-humoured, gentle, and even timid creatures, which live at peace with other animals, readily accustom themselves to the presence of well-disposed men, have no bad habits, and afford much entertainment by their astonishing feats of gymnastics. While most of the gibbons only scream and express their fear, excitement, or anger in that way, the siamang is said actually to sing and in fact to ascend the chromatic scale through a whole octave; and of the hoolock it is recorded, that it has a pleasant melodious voice, although the sounds that it emits cannot exactly be called singing. That older individuals when caught behave violently, biting and scratching, and that mothers, who are generally timid, defend their young even at the sacrifice of their own lives, are too common phenomena to call for any special remark.

The **Hoolock** (*Hylobates leuciscus* (*hoolock*)), of which an illustration is given, fig. 1, is perfectly black with the exception of a white fillet on the forehead, and even its teeth are dark coloured. It is a harmless creature, which prefers figs to any other kind of food, and is fond of roaming about in bamboo jungles. It has no throat-pouch, but has a loud voice. Unfortunately it does not live long in captivity, since it is accustomed to the moisture and heat of the low-lying parts of Bengal and the Eastern Peninsula.

A contributor to *Land and Water* (June 19, 1869) gives the following interesting account of two hoolocks which he had kept while resident in the north-east of India:—

"I was lucky enough to purchase a very young hoolock, which the one in my possession [an adult female] immediately adopted, and on the appearance of any danger it called it to itself, opened its arms to receive it, and springing with it into the nearest tree placed it in safety. One day a servant brought to me a large snake which he had killed, the sight of which caused the hoolock intense emotion. It called the young one to its arms, sprang up a ladder which was near at hand, and commenced a series of short howls, arching its eyebrows, and apparently calling the attention of the young one to the dangerous enemy in its vicinity. It refused to descend as long as the snake was in sight.

It played with the young one in the most interesting manner, ran after it, and dragged it about by its arms and legs, pinched it and pulled its ears, and the two would tumble heels over head on the grass together like two school-boys.

The young one was unfortunately strangled in a tree by a string which was round its neck, and the grief of its foster-mother was quite heart-rending. She examined it carefully, raised its lifeless hands with her own, and dropped them in deep despair. Again and again did she repeat the action, and on the removal of the body from her sight she sat disconsolately in the verandah, resting her head on her hand, and never tasted food for the remainder of the day. During the next morning she searched all the trees in the neighbourhood, and crept in and out of the house in a dejected manner, but in the evening she ate food and returned to the ordinary pursuits of apish life."

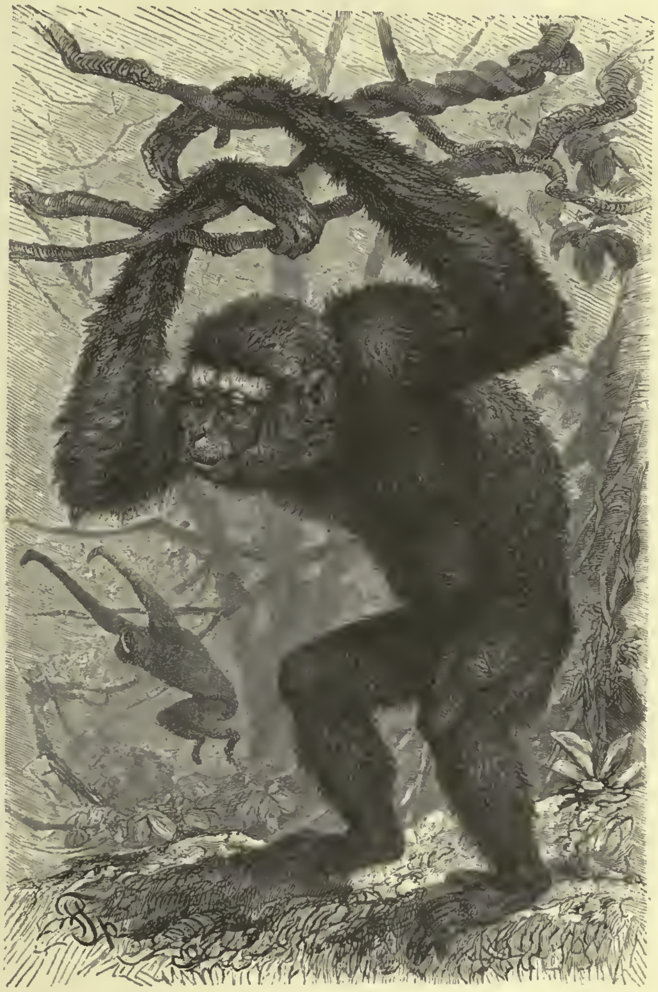


Fig. 1.—The Hoolock (*Hylobates leuciscus*).

The same writer states on the authority of M. Barbe, a Roman Catholic priest whose general accuracy is asserted to be well vouched for, that a mother hoolock "on being shot has been seen to take the young one from her neck, place it on the bough beside her, and then drop down dead at the feet of her destroyer."

The **White-handed Gibbon** (*Hylobates lar*), a pair of which are represented in fig. 2, is distinguished by having the whole of the face bordered with white, and the hands and feet white on the upper surface.

TAILED MONKEYS

(CAUDATÆ).

With more or less developed tail, ischial callosities, and mostly also cheek-pouches.

Anatomists have frequently drawn attention to the fact that the tail of these and the American monkeys, even when quite rudimentary, as in the Barbary ape, presents essential differences in the structure of the vertebræ when compared with the corresponding part in man and the anthropoid apes. But apart from these differences, to which we can only allude, great variety is shown in the development of this appendage, which, it must be added, is used only to guide the movements, especially in leaping, never as an organ of touch or prehension, as by the American apes. From the rudimentary stump of the magot or **Barbary Ape** up to a tail exceeding the body in length, as it does in many Semnopitheci and Cercopitheci, all possible transitions are met with.

Special attention is due to the ischial callosities, naked and mostly warty patches on the buttocks, frequently coloured by pigments, or sometimes only by the blood showing through. No doubt they are attributable to the sitting or squatting attitude which most of them adopt during the greater part of their life, and especially in sleeping. In many cases these spots are almost hidden by the hair, as in the gibbons. They attain their highest development among the baboons, and in the mandrill the various feelings of the creature are even expressed by variations in the colour of these patches, in the same manner and with the same clearness as in man they are expressed by blushing.

Cheek-pouches are very seldom wanting, but in some are only slightly developed. They are formed by an involution of the inner skin of the cheek, and at first are developed only below the opening of the mouth in the skin belonging to the lower jaw, and open inwards by a slit parallel to the opening of the mouth. When further developed they extend over the entire cheek. The monkey, on occasion of his plunderings of trees, gardens, and fields, when he must be constantly on his guard against enemies, whether beasts of prey or men, and constantly ready for sudden flight, stuffs these pouches with his hands and tongue as full as they will hold, in order that he may afterwards be able to consume the proceeds of his foray in quiet.

With respect to the general form of the body and the prominence of characters belonging to the lower animals, we see the most manifold transitions from very slender figures with small nearly round heads and slightly protruding jaws, to extremely robust, thickset, and even massive forms, with very protruding muzzle and a savage and bestial expression. Yet the limbs are mostly of equal length; and when not climbing, the usual mode of progression among these animals is walking on all-fours with the spinal column in a horizontal position, the head slightly erected, and the whole sole of the foot planted flat on the ground. A clear line of demarcation cannot be drawn in this respect between the separate groups. Among those monkeys which have massive forms there is a greater tendency to a terrestrial as distinguished from an arboreal mode of life.

Except on the face and the inner surface of the hands and feet the body is covered with hair, which is mostly, however, not very thick. Tufts on the head and tail, beards and whiskers, pencils and mantles of hair, are frequently developed.

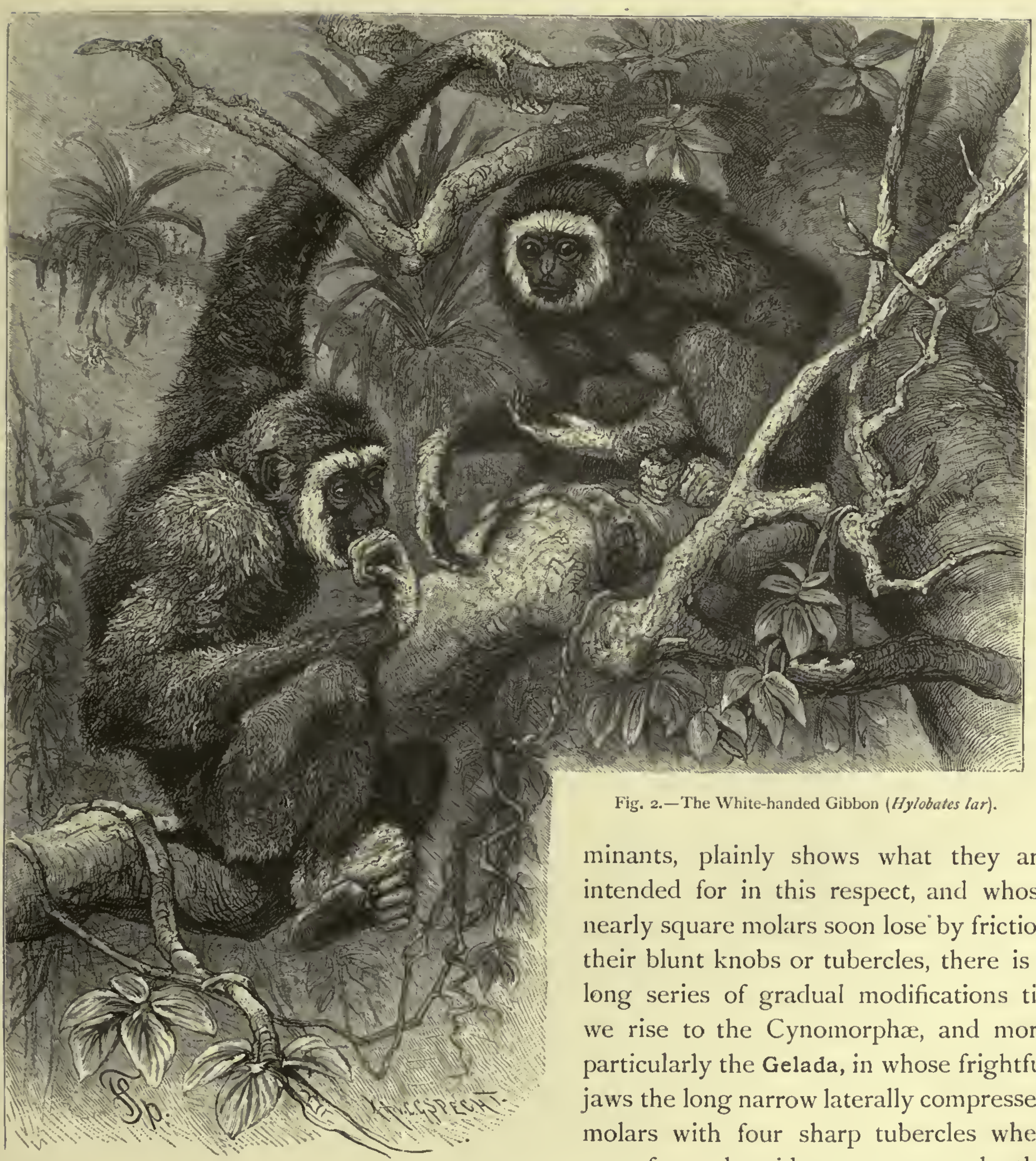


Fig. 2.—The White-handed Gibbon (*Hylobates lar*).

The chest is always flattened at the sides, not broad as in the anthropoid apes.

Although the dental formula

$$\left(\frac{2 \cdot 1 \cdot 2 \cdot 3}{2 \cdot 1 \cdot 2 \cdot 3} = 32 \text{ teeth}\right)$$

is the same in all tailed monkeys as in man and the anthropoid apes, yet there are considerable variations within this formula, variations which, apart from the definite form, are partly due to age partly to sex. From the herbivorous Semnopitheci, whose constricted stomach, almost adapted for ruminants, plainly shows what they are intended for in this respect, and whose nearly square molars soon lose by friction their blunt knobs or tubercles, there is a long series of gradual modifications till we rise to the Cynomorphæ, and more particularly the **Gelada**, in whose frightful jaws the long narrow laterally compressed molars with four sharp tubercles when seen from the side present exactly the appearance of the dentition of a carnivore. The last molar is sometimes larger, sometimes smaller, sometimes with four, sometimes with five tubercles, but these differences do not appear to have any influence on the rest of the organization.

As regards the significance to be attached to the canines it is necessary to be very cautious. If the enormous, sharp, curved canine with sharp cutting edge behind in the upper jaw of the Cynomorphæ, and above all in the gelada, can scarcely be matched even in the cat tribe, it should not be forgotten that this tooth is the last of all to attain its full development, notwithstanding that it cuts the gum sooner than others. It is, moreover, a tooth greatly affected by sex. All males among the monkeys have far larger canines than the females, and this disproportion, which is connected with the development of the jaws generally, and that of the ridges and borders of the skull, may become so considerable that we might often believe that we had before us skulls of two different species instead of skulls belonging to different sexes of the same species. Hence it follows that in this case the character of the canines as well as that of the whole dentition is influenced not by the nature of the food but by the duty of defence, which falls chiefly on the male.

With the development of the canines is connected that of the diastema or gap between the teeth leaving room for the canines of the opposite jaw. The teeth of the upper and lower jaw always fit into one another when the mouth is shut in such a manner that the projecting canine of the lower jaw becomes wedged into a gap behind the incisors of the upper jaw, while the canine of the upper jaw, usually considerably larger than that of the lower, gets similarly wedged between the canine of the lower jaw and the first premolar, the form of which is essentially modified thereby; but the size and depth of these gaps depends, as may easily be seen, on the size of the canines.

The original milk dentition always consists, as already remarked in the Introduction, of twenty teeth $\left(\frac{2 \,.\, 1 \,.\, 2 \,.\, 0}{2 \,.\, 1 \,.\, 2 \,.\, 0} = 20\right)$, and differs from the final dentition, not merely in the absence of the molars, but also in the greater strength and breadth of the inner incisors, in the smaller size of the canines, and the sharper tubercles of the premolars.

All tailed monkeys are diurnal in their habits, and most of them live together in herds of thirty or more, under the leadership of one of the older males, who is probably the patriarch of the whole troop, and usually maintains a strict rule. The monkey brings up his young in much the same way as man, often with excessive tenderness and great care, shown especially in combing, currying, and searching for parasites (a favourite occupation, represented in several of our plates). Males and females defend their young with bravery and fearlessness; but at the same time they punish them by boxing them on the ears, or cudgelling them, if they have committed any offence against the rules of the herd or have failed to render due obedience. They instruct them with the utmost zeal in all the arts necessary for life, they lead them about in their tender years, afterwards guide them in climbing, running, and leaping, and in seeking for food and hiding-places; in short, they look after their bodily and mental welfare like good parents.

Young monkeys are mostly ready for all kinds of games and sports, and easily tamed. In a troop of monkeys living in freedom there nearly always prevails bustling activity, continual commotion, and boundless gamesomeness, which only seldom degenerates into open quarrel and violence. In youth they are all sly, tricky, easily excited, observant, imitative, and it is only at a later stage, on reaching puberty, that the more disagreeable qualities come out, cunning, ill-nature, lasciviousness. Yet in these respects the most extensive gradations are observable, and between many Cercopitheci, good-humoured to excess, even stupid, and the savage ill-natured baboons, conscious of their strength, there is a wide chasm.

All tailed monkeys enjoy vegetable food, but perhaps the Semnopitheci are the only ones that feed upon it almost exclusively. Insects, eggs, birds, are readily eaten, and many, such as the baboons, feed chiefly on animal food, and do not even despise poisonous scorpions, millipedes, and large spiders.

UNIVERSITY OF CALIFORNIA

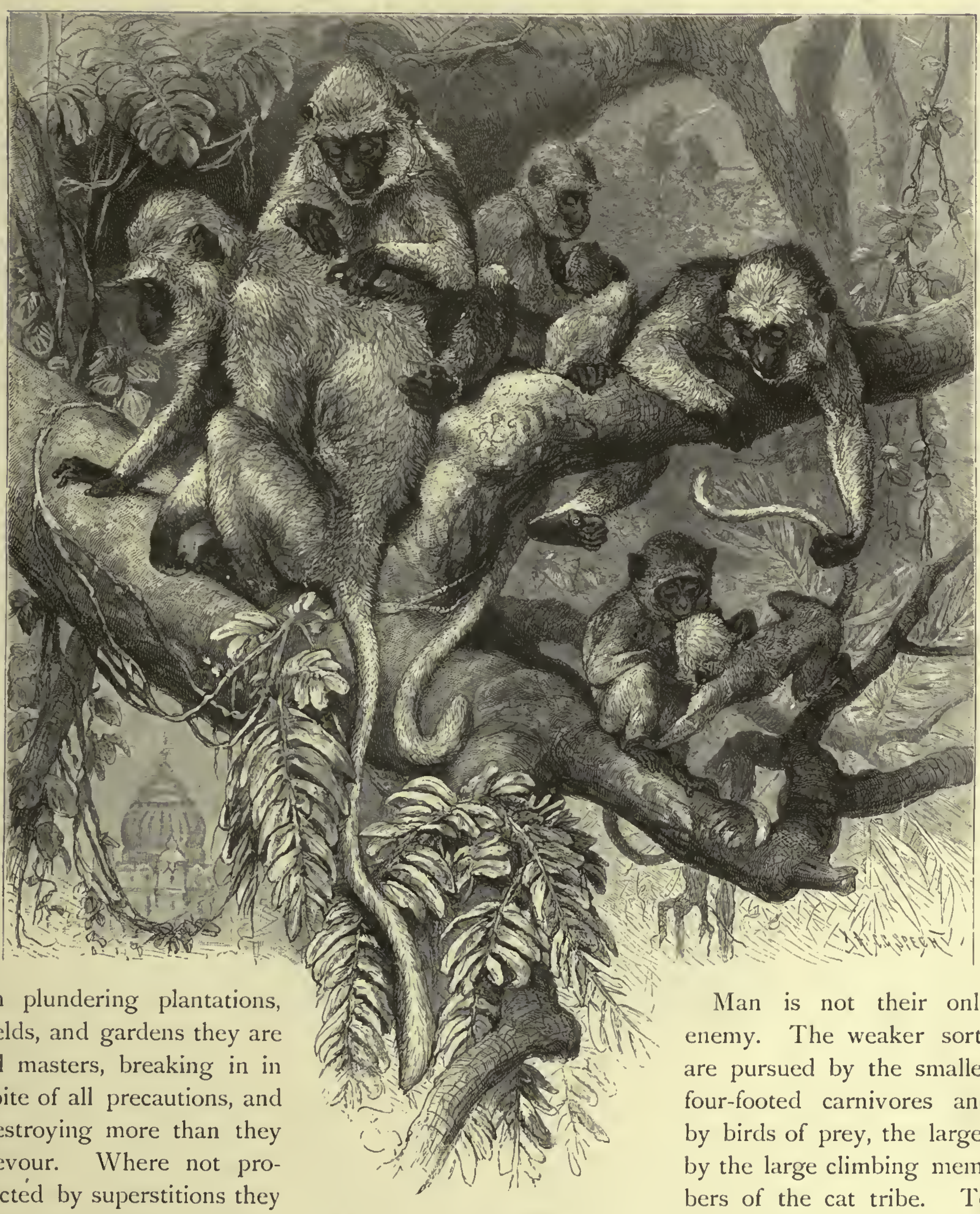


Fig. 3.—Family of Entellus Monkeys (*Semnopithecus entellus*). page 46.

In plundering plantations, fields, and gardens they are all masters, breaking in in spite of all precautions, and destroying more than they devour. Where not protected by superstitions they are in consequence relentlessly pursued by natives and settlers. When wounded they seek to quench the flow of blood by bandaging with leaves and grass. Most of them flee from man, but the large baboons make a stand against him, and are stated even to attack him at times. The flesh of most species is regarded as savoury.

Man is not their only enemy. The weaker sorts are pursued by the smaller four-footed carnivores and by birds of prey, the larger by the large climbing members of the cat tribe. To all, perhaps, serpents are the most dangerous enemies, and of these all monkeys show a great dread. The members of a troop stand by one another faithfully in danger, and we have reports from eye-witnesses, which must inspire us with genuine admiration of the high courage displayed by individual monkeys on such occasions.

That creatures so highly gifted and intellectually awakened should be easily tamed and trained in early years is just as little surprising as that they should change their disposition, and become cunning, ill-tempered, ill-behaved, ill-natured and ready to snap, when they are placed in confinement, even though they are collected, as is now customary, into large monkey-houses. This happens all the more frequently since it is the practice to cage up in the monkey-houses individuals of different species, which tease one another, while in a state of freedom only individuals of the same species herd together, and individuals which, moreover, are closely linked together by ties of blood. Even with the greatest care most monkeys in our climate become ill; they suffer from the want of the sun, the warmth, the forests of their homes. How can one then draw any inference from the behaviour of these sickly creatures, constantly teased and plagued by their fellows, as to the qualities which they display in the free life of their native woods?

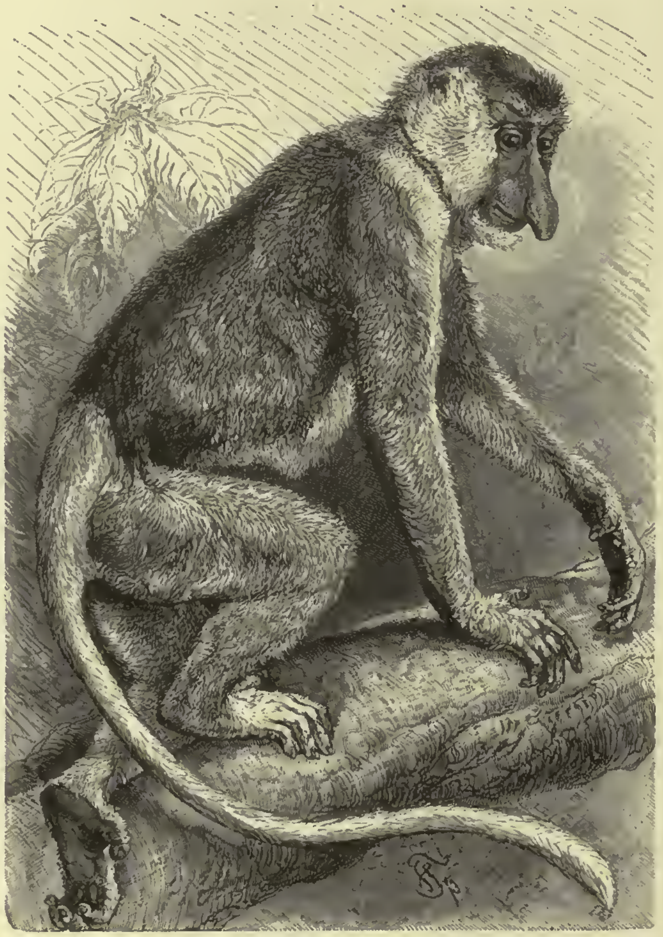


Fig. 4.—The Proboscis Monkey or Kahau (*Semnopithecus nasica*).

Owing to the gradual nature of the transitions between the different forms, separate groups can with difficulty be distinguished. From these groups we single out only a few well-marked representatives. In most genera there are many species but slightly different from one another.

Semnopitheci.

The monkeys belonging to the genus Semnopithecus are arboreal creatures of slender shape, with well-developed thumbs, long tails, a compound stomach of three parts, and sometimes with, sometimes without, cheek-pouches.

In the representation on p. 45 of a family of the sacred monkey of the Hindus, the **Entellus Monkey** or Hunuman (*Semnopithecus entellus*), a typical species of the genus is exhibited, engaged in its favourite occupations. The mamma is searching the fur of papa, who remains patiently and comfortably still under the operation. The oldest son is teasing some younger ones who are playing together, and in the background the daughter-in-law is nursing her offspring.

A round head with slightly protruding muzzle, slender neck and body, moderately long limbs with well-formed thumbs and great toes, the tail furnished with a terminal tuft of hair, and about a yard long, much longer than the body, which measures only some two feet; a rather rough coat of fur with hair spreading out in all directions and forming a stiff hood, as it were, round its warty visage; face, ears, hands and feet black, beard yellow, the rest of the fur whitish,—such are the principal external characters of this species of monkeys, which is distributed throughout the more low-lying regions of the East

Indies, having in some parts been introduced by man.

In India this monkey is held in great reverence, is regularly fed, and is nursed when ill. "Hunuman," says T. C. Jerdon in his *Mammals of India*, "the meaning of which is long-jaws, was one of the monkeys of the monkey-kingdom of Southern India, who aided Rama in his conquest of Ceylon, by forming a bridge of rocks opposite Manár, and greatly distinguished himself. His figure is often found in Hindoo temples in the guise of a man, with a black monkey face and a long tail: he is not worshipped, only greatly reverenced."

Flocks of it were at one time allowed to carry on their ravages unpunished, and the mischief which they wrought became at last in many places so intolerable, that the British government was obliged to take measures for the destruction of a number of them. Among themselves they are peaceable, and they are extremely lively, excellent jumpers and climbers, roaming about mostly in the tree-tops in great herds, under the leadership of an old male, and feeding on leaves, fruits, and even flowers. When young they are said to be clever and graceful, easily tamed, but always incorrigible thieves. When they grow old, on the other hand, they become irritable and violent, so that the younger monkeys generally separate themselves from the old ones. They thrive only in the hot plains, not in the mountains.

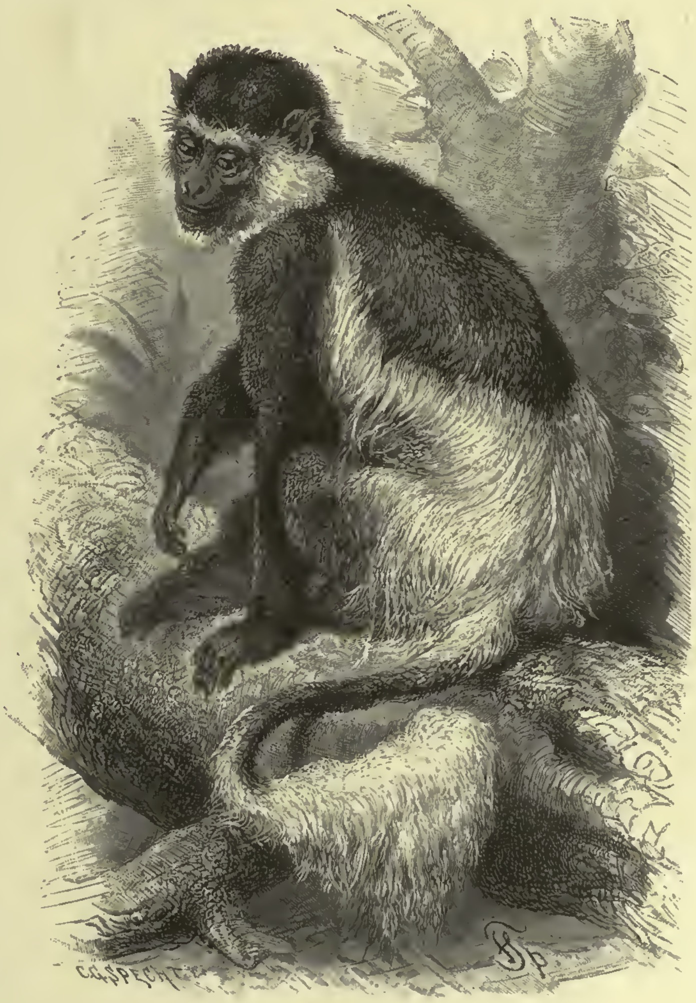


Fig. 5.—The Guereza (*Colobus guereza*). page 48.

Among the many species of the genus we single out one other very peculiar species, which has even been made the type of an independent genus, the **Proboscis Monkey** or Kahau (*S. nasica*), fig. 4, which lives in the hot lowlands of Borneo. The body is somewhat more robust than in the previous species; the fur is of various colours, very bright brown, yellow, dark brown, and white, and these colours are differently distributed in the female from what they are in the more brightly coloured male. The cheek-pouches are absent. In youth the kahau has an impudent-looking, turned-up pug-nose, which in another allied species (*S. roxellanus*), a native of Northern Tibet, is retained the whole life through; but with advancing years the nose, especially in the male, grows long and hooked, and at the same time thick and swollen, and this enlarged nose gets supported by plates of cartilage to which strong muscles become attached, enabling the creature to open its nostrils to an unusual width and close them again. The thin crooked end of the nose hanging down below the mouth is pointed and projects far beyond the nostrils. The very large curved canines of the male plainly show that the old monkey cannot be a very agreeable character. The kahau lives socially on trees by river banks, and utters a disagreeable loud howl, which the native name is intended to imitate.

Colobi.

African monkeys, resembling the Semnopitheci, but with more powerful jaws and much reduced thumb, and without cheek-pouches.

From this very rich genus, which is distributed throughout tropical Africa, we select for illustration the **Guereza** (*Colobus guereza*), fig. 5, which Rüppell discovered in Abyssinia, where it inhabits the mountain forests at a height of from 6500 to 10,000 feet above the sea. This slender long-tailed monkey is black, with a narrow white band above the eyes, white beard and whiskers, and a white tuft at the end of its tail. As the animal grows older long, fine, soft, white hairs grow out in an elegant curve extending from the shoulder-joint to the small of the back, and these form a spreading mantle in the old males. This monkey is social in its mode of life, is extremely adroit and bold, and carries on its pranks in the high tree-tops, where only a rifle bullet can reach it. The Abyssinians formerly used its fine coat as a covering for their shields.

The Colobi represent on African soil the Semnopitheci of Asia, with which they agree in the form of the body and in the possession of a long tail and compound stomach. But the jaws are more powerful. In an old guereza male the tendons of the muscles form a ridge on the skull almost like that of a carnivore, and the curved cutting canines are weapons not to be despised. The molar teeth get worn away by use in such a manner that only an external plate of enamel remains standing, which gives the teeth when seen from the side the appearance of a saw. The small size of the thumb is characteristic in all Colobi, that member being sometimes represented only by a stump or a wart, and sometimes altogether absent. The great toe is normal in structure.

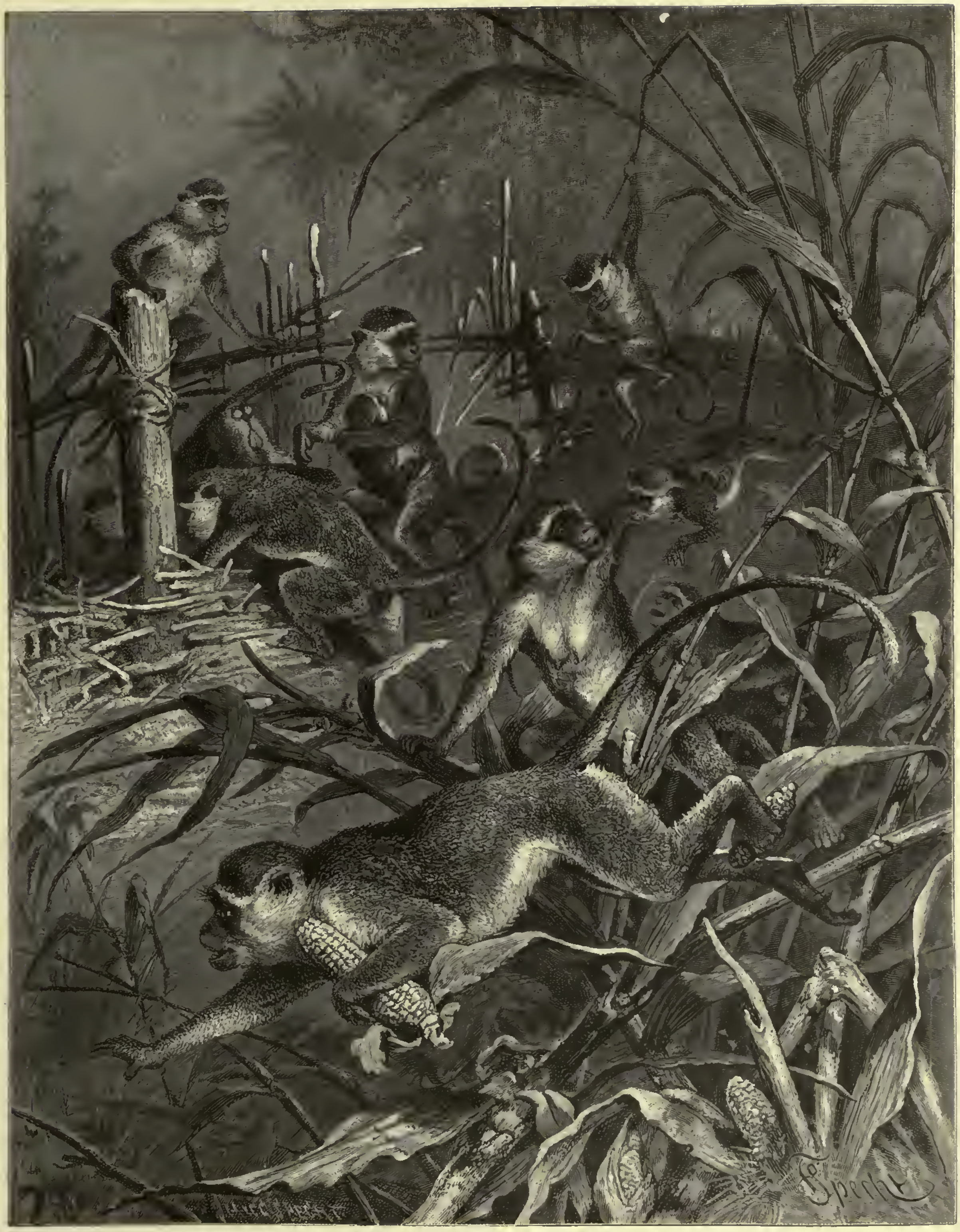
The Guenons (*Cercopithecus*).

African monkeys with simple stomach, cheek-pouches, long tail, large thumb, and moderately long limbs.

This is an arboreal genus, the more slender species of which would scarcely have been separated from the Semnopitheci, were it not that the jaws are more powerful and the stomach simple. They inhabit the whole of tropical Africa, as well as our zoological gardens; and in general are good-humoured, easily tamed, and readily bring forth young in captivity. Most of the general characteristics of these monkeys are sketched from tame captive specimens.

Various sub-genera have been established very unnecessarily, the distinctions being founded on the number of tubercles on the wisdom teeth in the lower jaw. Those with three tubercles form the sub-genus Myiopithecus, to which belongs the **Talapoin** of West Africa, which on account of its large ears and broad nasal septum reminds us of the American monkeys; those with four tubercles form the sub-genus Cercopithecus, the typical and most numerous group, to which belongs the **Diana Monkey** of our illustration, fig. 6, as well as the **Mona** and the **Green Guenon** (*C. sabæus*); those with five tubercles, the sub-genus Cercocebus, constituting the **Mangabeys** of the traders, among which the snout is rather longer than in the others, somewhat baboon-like, as it is also in the *C. fuliginosus* of West Africa.

The colour of the fur is very various. The larger and somewhat sturdier species are usually of a uniform colour, green; the **Talapoin** and the common **Green Guenon** which ascends high up among the mountains and stands our climate best, grayish black; the **Mangabey** or **Moorish Monkey**, yellow or reddish-brown; the **Hussar** or **Nisnas Monkey**



To face page 48.

PLATE IV. — GREEN GUENONS (*Cercopithecus sabæus*) PLUNDERING A MAIZE-FIELD.

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

(*C. pyrrhonotus*), variegated with differently distributed coloured spots, and mostly also furnished with curious pencils of hair, beards, and tufts like the Semnopitheci. These are the chief typical species. The last-mentioned species, a native of Nubia and Darfur, is common in our zoological gardens, and is agreeable in its ways when young, but sullen and tiresome when old. The Diana monkey (*C. diana*) is a pretty little creature of a slate-gray colour, which becomes darker on the back and inclines to brown; its face has a triangular white border, which ends in a long pointed beard, and is continued down the neck, breast and arms to the fore-arm; its legs are white on the inside, and it is provided with a long tail without a terminal tuft. It belongs to West Africa, and is often found along with the mona in our zoological gardens and monkey-houses. From the mona, which is similarly marked, it is distinguished by the possession of a long beard. In its behaviour it makes itself a favourite by its good-nature.

The **Green Guenon** (*C. sabæus*) is a creature of more powerful frame, approaching more nearly to the macaques; olive-green on the back, with a blackish cap on the crown. On Plate IV. a troop of this species is represented surprised in the plundering of a maize-field. The alarmed animals are trying to save their booty and their young by a hasty flight, while their leader on the fence keeps watch for the threatening danger.

All the guenons live in troops, often counting more than a hundred head. They are cunning thieves, and subordinate themselves in all their movements to the old male which acts as their leader. Like most other monkeys they have manifestly a means of communicating with one another through the modulation of their throat-tones. On account of their depredations they are thoroughly detested by the natives, who catch them chiefly with nets under which they place fruits as bait. They are extremely fond of eggs, but do not despise insects.

Macaques (*Macacus*).

With a solitary exception Asiatic monkeys, with a rather thickset frame, protruding muzzle, tolerably powerful jaws, simple stomach, cheek-pouches, and a tail which never grows longer than the whole body.

According to the degree of development of the tail several sub-genera have been established under this genus also: first, those with long tail, to which belong the **Java Monkey** (*M. cynomolgus*) and the **Malbruk** or **Bonnet-monkey** of Malabar; next those with only a moderately long tail, such as the **Wanderoo** (*M. silenus*) and the **Boonder** (*M. rhesus*); and lastly the **Magot** or **Barbary Ape** (*Inuus* or *M. ecaudatus*), with a short skinny stump, found in Algeria, Morocco, and on the rock of Gibraltar.

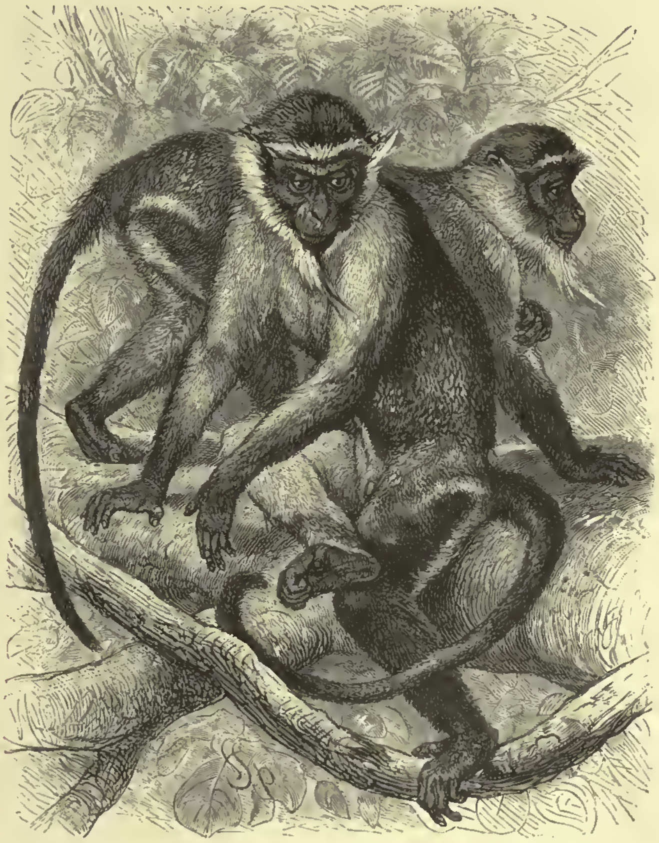


Fig. 6.—The Diana Monkey (*Cercopithecus diana*). page 48.

When the whole series of macaques is carefully examined it is easy to perceive a gradual transition from arboreal to terrestrial forms, a transition still more marked in the baboons.

The head is large, the muzzle protruding, the crest and borders of the skull as well as the supraorbital ridges are very prominent, the body and the limbs powerful, the latter almost equally long, the thumb and the great toe highly developed. The canines are very conspicuous, the tubercles on the molar teeth are more pointed, the organs of generation more prominent, and the ischial callosities larger than in the previous groups. Their coat is mostly of a uniform colour. Some species ascend high among the mountains, even to elevations in which severe winters prevail.

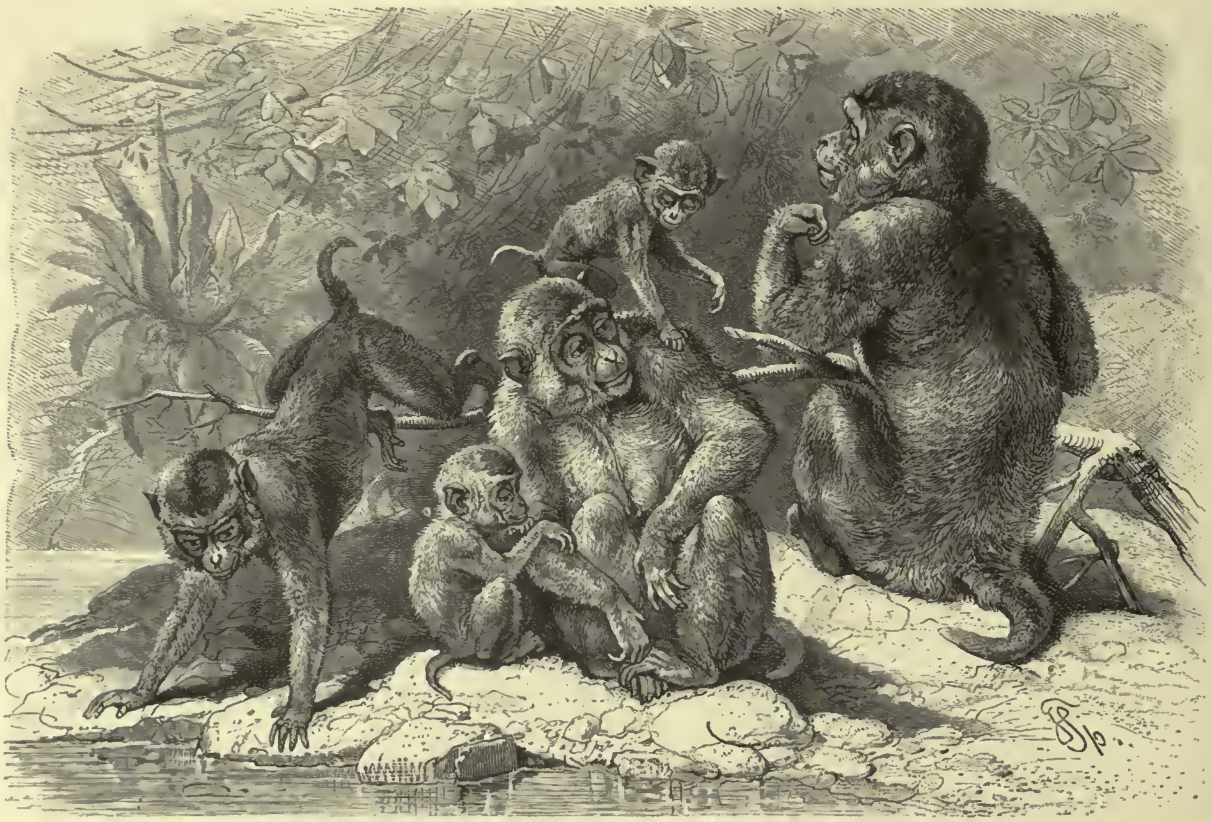
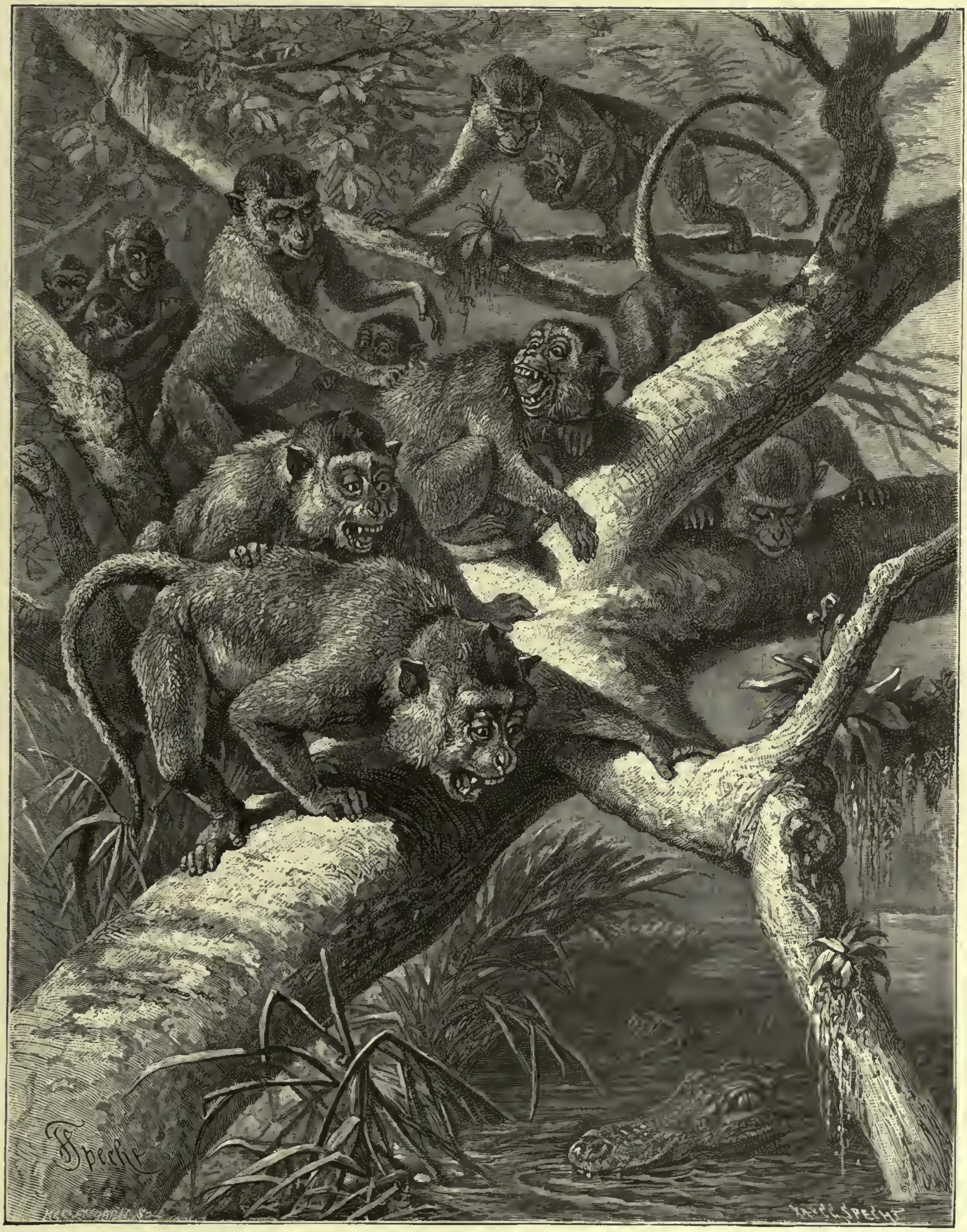


Fig. 7.—Group of Rhesus Monkeys (*Macacus rhesus*). page 51.

Without doubt these monkeys, which always live in troops under the leadership of an old male, exhibit a high degree of mental development, and in this respect, and consequently also in capability of being tamed, they are far in advance of most of the other groups. But if Semnopitheci and Cercopitheci are rather shy and even cowardly, the macaques show greater confidence in their strength, and therefore exhibit more boldness and we may say impudence in all their doings. Although to be sure they are likewise expert gymnasts and climbers, they are not to be compared in respect of lightness and grace of movement with the specifically arboreal forms. If we may judge from the unseemly behaviour of the captive specimens they appear to be of a rather sensual nature, although in this regard they do not equal the baboons, who display an incredible degree of grossness, a fact of which one has only too many opportunities of being convinced in monkey-houses. In captivity they pair readily, and they are fruitful not only among themselves but also with other allied species. In respect of their love for their offspring and their readiness to defend them, as well as in all other habits and



To face page 50.

PLATE V. — GROUP OF JAVA MONKEYS (*Macacus cynomolgus*).

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

qualities, they resemble other monkeys. The species are numerous, and since many are distributed over wide areas, it is often difficult to decide whether one has to deal with species or varieties.

The **Java Monkey** (*M. cynomolgus*) is frequent in monkey-houses, but not much liked. It is filthy, sensual, and intractable. An olive-green colour with a black cap on the crown for the most part characterizes this monkey, which, however, varies very much in colour. It was originally distributed over all the islands of the Eastern Archipelago and over the Malay Peninsula, and has been carried by man as far as the island of Bourbon, where it has become wild. Plate V. shows a group of these monkeys frightened away while in the act of drinking by a crocodile emerging from the water.

A family group of the **Boonder** (*M. rhesus*), fig. 7, which is found almost throughout the East Indies but especially on the Ganges, has been figured for two reasons, first because it represents an intermediate type of the genus, and secondly because it plays in some districts a similar role to the hunuman. This tolerably large monkey, whose skin gathers in folds on the neck, breast, and abdomen, is greenish-gray on the back, and whitish on the under surface, which is only sparingly covered with hair; the naked parts, face, hands, and feet, are of a bright copper colour, the large ischial callosities bright red. An allied species, the *Macacus erythræus*, is similarly coloured, but much larger and slenderer. Both species climb high up the Himalayas at Simla, and even tumble about in the snows of the pine-forests, but yet appear in large part to descend in winter to the lower regions, where they prefer the bamboo thickets on the borders of the streams. They swim and dive admirably, and even take refuge in the water when pursued.

Through the reverence which is paid to them by the Hindus these monkeys, conscious of their immunity from punishment have become as intolerable devastators as the hunuman, and all that was said with reference to that monkey applies also to the open-air life of this one. When caught young they are easily tamed, and they are favourite actors in monkey-theatres. When old they become irritable and malicious, and torment their weaker companions in the monkey-houses in all conceivable ways.

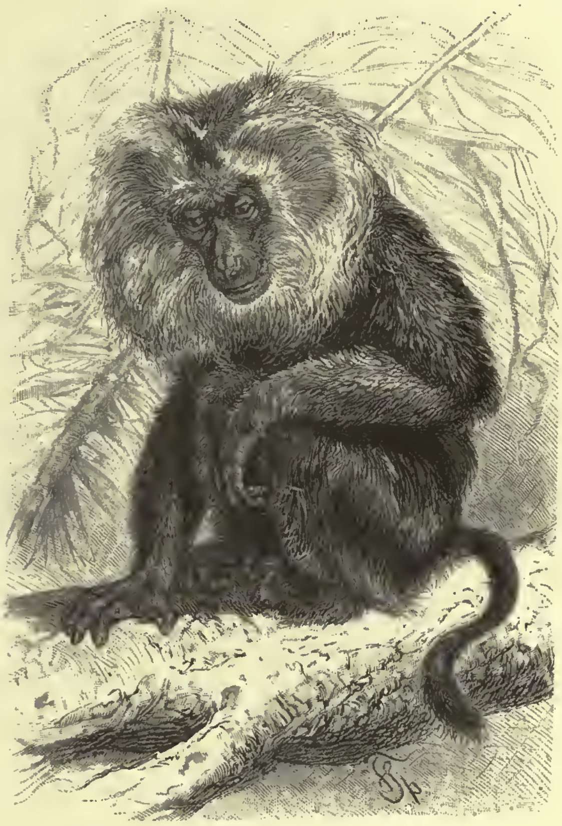


Fig. 8.—The Wanderoo (*Macacus silenus*).

The long protruding muzzle with the large curved canines, the thickset body, and the relatively short limbs in the **Wanderoo** (*M. silenus*), fig. 8, mark the transition to the baboons. The dark-coloured face is surrounded by long white beard and whiskers, beginning above the eyes and leaving only a narrow strip free above the root of the nose. The long fine fur is black behind, brighter in front; the naked parts, ears, hands, and feet, black, the ischial callosities of a pale red. The rather short tail has a tuft at the end.

In spite of the devastations which he is said to commit at times in cocoa-nut plantations, but which cannot be very serious, seeing that he lives mostly in the great forests, the facility with which he is tamed causes him to be much liked in his native country of Malabar, as a domestic animal and "comedian;" and he is frequently exported to Ceylon, whence he is brought to European zoological gardens and monkey-theatres. His behaviour is good-natured, even "dignified," as many observers declare; according to the accounts given of him we might call him the philosopher among the monkeys. Some observers even maintain that his remorse on account of faults of which he has been guilty may cause him to shed tears, which would certainly bring him very near man in respect of the expression of his feelings.

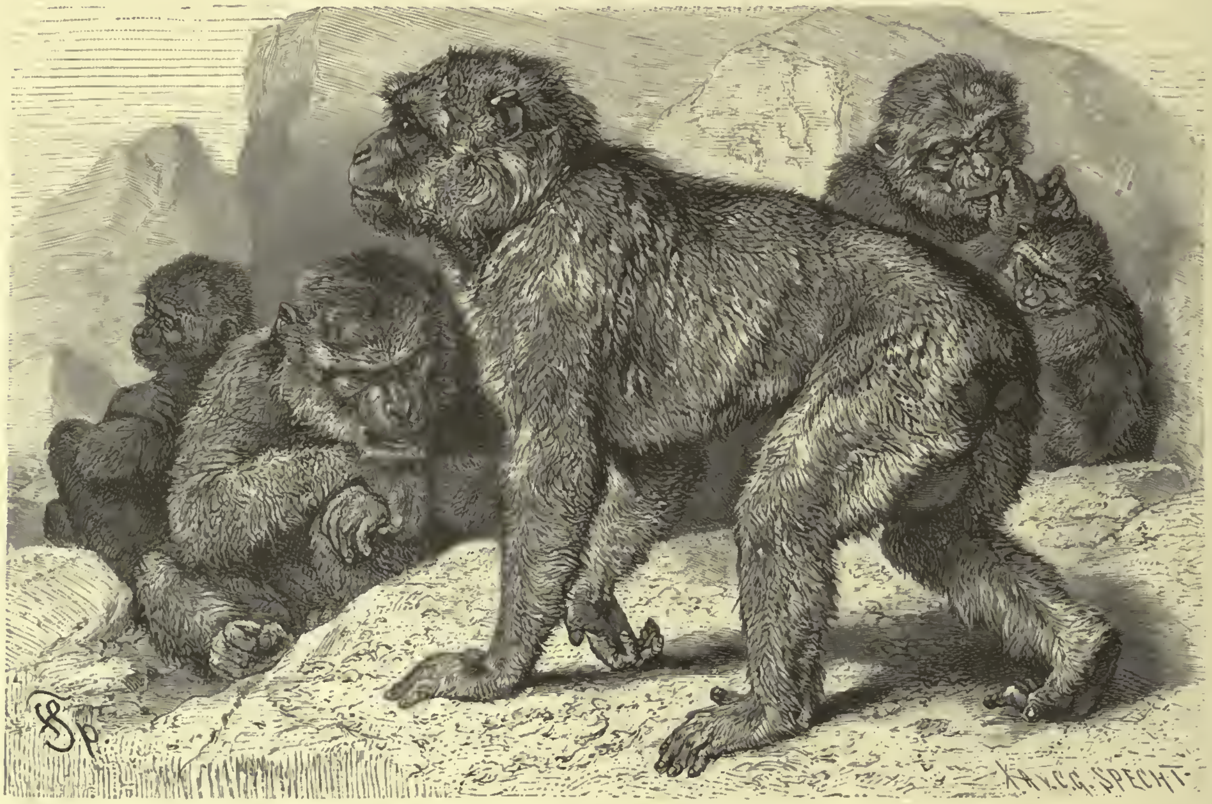


Fig. 9.—The Barbary Ape (*Inuus ecaudatus*).

And now for thee, last witness upon European ground of the climate of a bygone age, still dwelling in a small troop on the rock of Gibraltar, formerly almost the inseparable companion of the European camel-drivers, the tailless **Magot** or Barbary Ape (*Inuus ecaudatus*, *Macacus Inuus*), fig. 9. The sparse woods on the rocks of North Africa are now the chief home left for this creature, but the destruction of the woods and the advance of civilization, leading to the rooting out of the alfa grass for industrial purposes, have made this ape, which was known even to the ancients, almost a rare animal.

When the French, after the conquest of Algiers, stormed the romantic defile of Shiffa, hundreds of these creatures darted up the rocky precipices amidst piercing cries; now the tourist but seldom catches sight of one with his telescope; and the traveller may entertain some doubt whether, after all, it is not a half-wild ape which the speculative host feeds, and thus keeps attached to some almost inaccessible spot.

Although good climbers and gymnasts, the magots are essentially terrestrial forms, with long powerful legs, slightly protruding muzzle, and good-natured eyes; and they can be recognized at the first glance by the want of the tail, which is merely indicated by a small tubercle of skin. The dense shaggy fur is somewhat of a mouse-colour, inclining sometimes to brownish-red, sometimes to olive-green, darker on the back, brighter in front and at the sides of the face. The naked parts are flesh-coloured.

On the whole good-natured, and inclined to frolic and fun, they are, at the same time, easily irritable and courageous creatures, dwelling chiefly on the rocks, and feeding on fruits, juicy leaves, and, in particular, also on the roots of the dwarf-palm, and often turning up stones to devour the insects, millipedes, scorpions, and even small lizards which they catch under them. They are expert in extracting the sting from scorpions, but of serpents they have a great dread. Sensitive to cold, although they inhabit places where snow falls every year in winter, they change their quarters according to the prevailing wind, a fact which has been clearly observed, particularly in Gibraltar. The troop which lives there was originally beyond question the last remains of numerous flocks which in Pliocene and Post-Pliocene times were distributed throughout the countries bordering on the Mediterranean on the north wherever the dwarf-palm (*Chamærops humilis*) was to be found; but since that troop, notwithstanding all the efforts of the English to preserve it, has several times been on the point of extinction, it has been replenished from time to time by specimens brought from Tangiers. The animals are, however, allowed to live on the rock in perfect freedom.

Baboons (*Cynocephalus*).

Large, chiefly African terrestrial forms, with dog-like muzzle, powerful limbs, and dentition like that of a carnivore.

The giants of this genus, the gelada and the hamadryas, attain when sitting the full height of man, and appear smaller only when standing, on account of the relative shortness of the legs. Though scarcely any smaller than the gorilla they are inferior to it in breadth of shoulders and chest, which latter in the baboons is narrow and compressed.

While in the young the skull is rounder than in mature animals, though the muzzle is from the first very prominent, in the old males, as in the case of the anthropoid apes, there are developed very marked crests and ridges on the top of the skull and in the upper part of the orbits; and frequently the middle ridge, to which the powerful muscles for closing the mouth are attached, is so highly developed that it forms a conspicuous feature even in living animals. The muzzle is not only very protruding, as already stated, but also rapidly receding at the sides, and the dentition is fearful. The canines with their sharp hinder edge resemble curved daggers, the molars are laterally compressed so that they become longer than broad, and their tubercles acquire a cutting edge. The body is powerful, so also are the legs, and the thumbs and great toes are well developed; the tail is never as long as the body, and is frequently provided with a terminal tuft; sometimes it is altogether rudimentary. Founding on this character as well as upon the position of the nostrils, which are sometimes at the end of the snout, sometimes further back, some naturalists have divided the genus into several sub-genera: Cynopithecus, with nostrils far back and rudimentary tail, comprising only the **Black Ape** (*C. niger*), the sole Asiatic representative of the whole genus; Theropithecus, with similarly situated nostrils, but with moderately long tail, the sub-genus to which, the **Gelada** (*C. gelada*) of Abyssinia, is referred; Cynocephalus, with long tail and nostrils at the end of the muzzle, the sub-genus to which the **Arabian** and the **Common Baboon** belong; lastly, Mormon, with nostrils in the same position, but rudimentary tail, the sub-genus of which, the **Mandrill** (*C. Mormon*), may be taken as the representative. The more slender limbs and body, and the somewhat arboreal habits of the **Black Ape** ally it more closely than any of the others to the macaques, and in particular to the wanderoo, and thereby indicate its Asiatic home. The more powerful thickset frame and the terrestrial habits of life are more marked characteristics in the others. In a state of freedom the baboons never walk upright, but always on all-fours, their hinder quarters waggling from side to side. Many of them have never been seen on trees, others only very seldom, and especially when bayed by dogs. Among the rocks on the mountains, however, they show themselves to be first-rate climbers, the smallest projection enabling them to take a firm foothold.

So far as our information goes, it would seem that all baboons live mostly in considerable troops, often numbering several hundred, and in these there are always several old males and females, so that the leadership does not, as among most other monkeys, fall to a single patriarch. This shows in itself, beyond question, a great capacity for mutual accommodation among the creatures, which of course does not exclude the possibility of sundry little quarrels and scrimmages. The troop passes the night in caves in the rocks, and in grottoes on inaccessible precipices, all closely huddled together, and at sunrise they slowly and deliberately quit their retreat in search of food. Large stones are often overturned by their united efforts in order to seek for any animals that may have crawled under them, such animals forming, along with roots, tubers, juicy leaves, and fruits, their chief nourishment. After that the company bask in the sun with their backs turned to the wind, the older ones sitting on stones, while the young tumble and play about. The old, meanwhile, keep a careful watch all round; the troop next go to some water to drink, and after supper they betake themselves once more to rest. For the most part a troop sticks to the same feeding-ground, for some time at least, but from time to time it changes its ground.

On the approach of any danger warning sounds are heard, and the females and the young then crowd together, while the old males, like the champions of the ancient Greeks, advance into the foremost of the fight uttering fearful cries, bellowing, and gnashing their teeth. A bold and proud spirit with contempt of death is beyond question a characteristic trait of the baboons, and when Brehm records a case in which an old Arabian male baboon gradually managed to extricate a young one, which had been left behind on a rock surrounded by dogs, from the midst of its assailants and before the very eyes of the hunters, inspiring by its determined bearing both dogs and hunters with such respect for its powers that no attack was ventured on, we may well agree with Darwin in saying that here was a proof of heroism of which only few men were capable.

But the reverse side is not wanting. All observers agree in describing the young baboons as extremely docile, infinitely comical, clever, sly, tricky creatures, while they cannot find words enough to denounce the abominations of all kinds that characterize the old baboons. It is true that they are all in the highest degree gross and sensual, and probably it is not without good ground that it is everywhere said by the natives that the negresses are not safe from the attacks of the large baboons. But if old baboons in captivity are rightly depicted as treacherous, extremely ill-natured, intractable and ready to bite, this development of character may have its ground in the confinement, which embitters the disposition of the intelligent creatures. For my own part it is impossible for me to find in this defiant reaction against unworthy treatment a proof of natural depravity, and in the accounts given of their habits in a state of freedom I find no evidence of that, but only of their social virtues and of their brotherly readiness to stand by one another in presence of danger. That the consciousness of strength will lead to many an act of insolent outrage can be easily understood; but that the large baboons do not give way even to the leopard and do not flee before man himself when not bearing firearms, can hardly be reckoned as a fault.

The **Black Ape** (*C.* (*Cynopithecus*) *niger*), fig. 10, with slender limbs, very dark woolly fur, and rudimentary tail, we have felt compelled to depict as representing the macaque type. It inhabits the easternmost islands of the Eastern Archipelago, Celebes, the Moluccas, and the Philippines, is regarded as easily tamed, but is not known in a state of freedom.

Among the mountains of Eastern Central Africa there lives a group of large baboons, which have been denominated the mantled baboons, because the males in particular have a luxuriant covering of hair a foot long, forming a perruque and a mantle for the shoulders, reaching down to the elbow. These large and powerful monkeys appear to some extent to have the highlands of Abyssinia as the central point of their distribution. The larger species, the **Gelada** (*C. gelada*), inhabits here only a zone of 6500–10,000 feet above sea-level, while the **Arabian Baboon**, which, among the ancient Egyptians, played the same role as the hunuman and the boonder still do among the Hindus, is far more widely spread and descends even to the valleys. Formerly it was a native of Egypt, where it is now quite extirpated, but it still extends to the mountains of Arabia. Both species have a terminal tuft on the tail, and otherwise they show only slight divergences. The Arabian baboon (*C. hamadryas*), which when old is of a silver-gray colour, but in youth is darker, has nostrils at the end of the snout and large bright-red ischial callosities. Its figure is frequently represented on the Egyptian monuments, and it has lent its head to some of the ancient Egyptian gods.

The larger **Gelada**, of which we furnish an illustration, fig. 11, is met with at more considerable altitudes, has the nostrils situated far back, two naked spots on the breast, and small dark-gray ischial callosities. The naked parts are blackish. There is a brown and a black variety, the latter, which the Abyssinians distinguish by the name "tokur sinjera," and which is characterized especially by having claw-like nails on the fingers, confined to the greatest elevations. In quite recent times sixteen specimens of this variety were brought alive to Europe by their capturer, J. Essler of Hungary, and as many perished during the journey. Even the old captive animals were tolerably well tamed at the end of half a year. They never exhibited the bestial brutality and readiness to bite which are displayed by the hamadryas. The male, which is considerably larger than the female, defended the latter and one young one against imprudent approaches by sound blows with the hand. When they thought themselves alone the

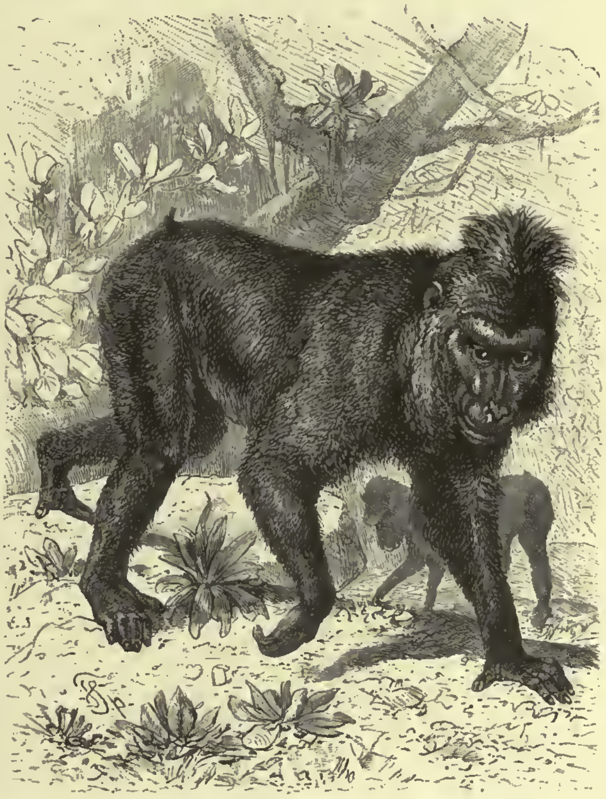


Fig. 10.—The Black Ape (*Cynocephalus niger*).

LIBRARY UNIVERSITY CALIFORNIA

members of this family amused themselves. The tones of the voices of these animals, says one observer, were so variously modulated and accentuated that people were involuntarily induced to believe themselves in the presence of beings endowed with the gift of speech. The mode of speaking of these intelligent creatures reminded one of the inarticulate sounds uttered by men whose speech is impeded by an organic defect in the *frænum linguæ*.

In fig. 11 a herd of geladas is represented during a period of repose. A patriarch sits on a rock in the foreground, accompanied by a female and two young ones at play. In the background the members of the troop are employed in searching for food and in playing.

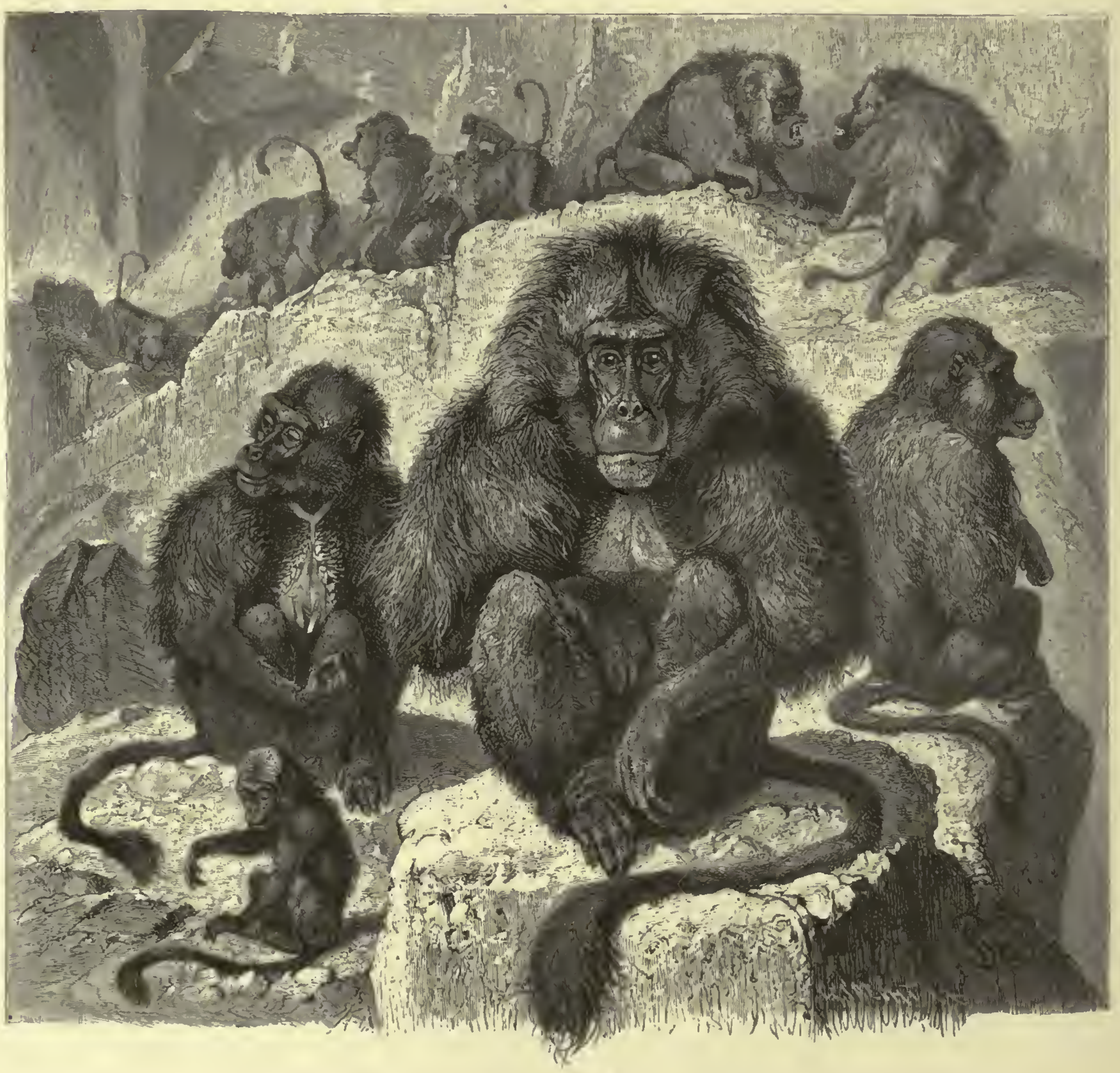


Fig. 11.—The Gelada (*Cynocephalus gelada*). page 55.

The mode of life of all these species is the same, namely, as above described. The gelada and Arabian baboon are said, however, to live at great enmity with each other, and often to break out into open hostilities to decide frontier disputes, on which occasions the combatants occupying the higher positions roll stones down upon their antagonists.

Accounts of this rolling and throwing of stones against enemies ascending from the valley are met with in all the narratives of hunting expeditions and other invasions of their domain, just as invariably as in the tales of the battles round Troy. The hostilities between these monkeys, however, are said to be confined to horrible grimaces, bellowing, gnashing with the teeth, beating the hands on the ground, and tearing the hair from perruques and mantles, and only seldom to lead to serious wounds with the teeth.

The **Common Baboon** (*C. Babuin*) which inhabits Central Africa from Abyssinia to Mozambique, may be taken as representative of the maneless smooth-haired baboons, which in walking on all-fours always carry the tail curved as depicted in fig. 12. The **Chacma** or Pig-faced Baboon (*C. porcarius*) and the **Guinea Baboon** (*C. sphinx*) are allied, though somewhat larger and differently coloured species. All three are frequently brought to Europe, but most frequently the mouse-coloured baboon with the dark back, which on account of its docility and good-nature is never wanting as an actor in the monkey-theatres. The mode of life of these creatures in a state of nature resembles that of the mantled baboons, their food is the same; their otherwise good qualities are frequently, as in the case of the latter animals, thrown into the shade by the violence of their sexual instincts. At the Cape the chacma is hated and eagerly pursued on account of its destructiveness, cunning, and savage disposition; but, on the other hand, it is also frequently tamed and employed in searching for water, for which employment it is said, like most baboons, to manifest a peculiar fitness, even when the water lies at a considerable depth below the surface. Water is a real necessity for all baboons on account of the frequently dry character of their food. Their halting-places are always selected in the neighbourhood of water, and it is therefore all the more singular that they cannot swim, but sink to the bottom without being able to save themselves.

In South Africa baboons are often very destructive amongst the sheep and crops of the farmers. Anxious to indulge in a little baboon hunting by way of recreation on the borders of the Orange River Free State, Dr. Emil Holub on one occasion made inquiries of a farmer as to how to proceed in order to gratify his wish. The farmer was at once extremely communicative. So pitiable was his account of the losses he had in various ways sustained through the baboons, writes Dr. Holub, "we could well understand the grin of satisfaction with which he learnt our object. He became more and more loquacious in his desire to render information; and when I further explained to him that we were anxious to get some of their skins to stuff, and to carry off some of their skulls, he was quite astounded; he had never heard of such a thing, and exclaiming, 'Allmachtag, wat will ye dun?' he walked off, shaking his head, to tell his wife of the doctor's 'wonderlijke' proposal to shoot a 'babouin,' and to send its skull all the way to 'Duitsland.'" It was resolved to lie in ambush for the baboons at their drinking resort. "Only a few minutes had elapsed when one of the farm-boys drew our attention to what seemed little more than a couple of dark specks on the slope of the hills to the right; but we could soon see that they were moving, and when they came within half a mile of us, we could distinctly recognize them as a herd of baboons. The boy said he was quite sure that they were on their way to the water; but to our surprise they did not make any further advance. A quarter of an hour elapsed; half an hour; still no symptom of their approach. All at once, as if they had started from the earth by magic, at the open end of the pond, not sixty yards from our place of ambush, stood two huge males. When or how they had got there no one could tell; probably they had come by a circuitous way through the valley, or it might be that they had crept straight down through the grass; they had certainly eluded our observation.

Being anxious to watch the movements of the animals, and to ascertain whether they belonged to the herd playing under the mimosas, I refrained from firing, and determined to see what would follow next. Both baboons sprang towards the water, and leaning down, drank till they were satisfied; then, having gravely stretched themselves, they stalked away solemnly on all-fours in the direction of the herd. There was little doubt, therefore, that they belonged to them, and had been sent forward to reconnoitre; for as soon as they got back, the entire herd put itself in motion, and made its way towards the pond. There were mothers taking care of their little ones; there were the half-grown animals, the boys and girls of the company; but there did not seem to be more than three or four full-grown males. At first only one baboon at a time came to the water's edge, and having taken its draught retired to the rest; but when about ten of them had thus ventured separately, they began to come in small groups, leaving the others rolling and jumping on the sand. . .

It was not long before two males—the same, I had no doubt, which we had noticed before, came and squatted themselves one on each side of the little creek, which certainly was not more than two feet across. When they stooped to drink, their heads could not have been four inches apart. Here was my chance. Crack went my rifle. But instead of either of them dropping, the two baboons started up; by a mutual instinct they both clutched their noses, gave a ringing bark and scampered off. The whole herd took the alarm, and joining in the shrieking clamour, were soon lost to sight. One or two, however, of the larger animals seemed to lag behind and to look inquiringly, as if to ascertain the true condition of affairs.

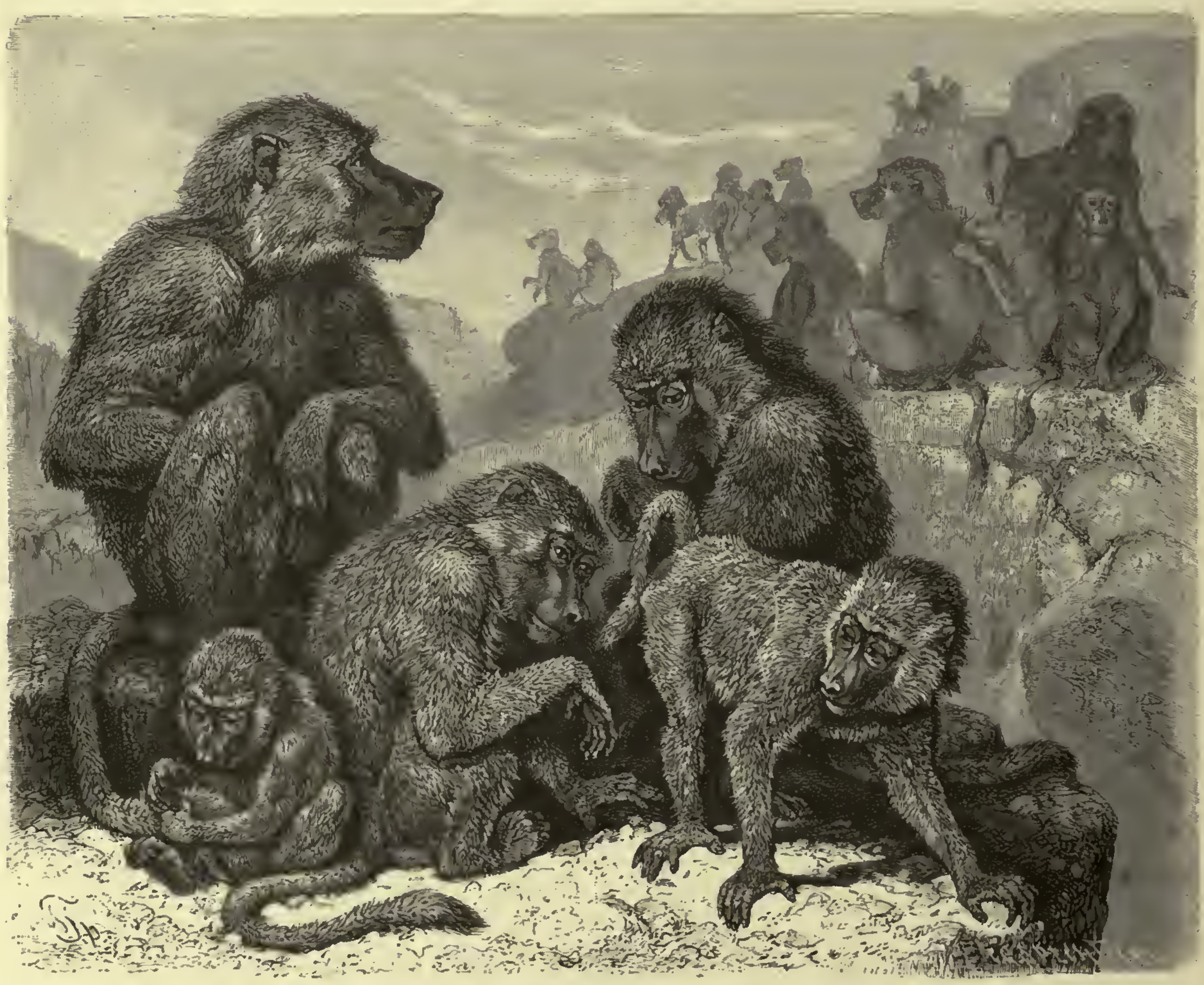


Fig. 12.—The Common Baboon (*Cynocephalus Babuin*). page 57.

We went down and examined the spot where the baboons had been drinking, and could come to no other conclusion than that the bullet had passed exactly through the narrow interval that had parted their heads; it had lodged just about three feet behind them."—Holub, *Seven Years in South Africa*, vol. i. chap. iii.

The following account of the behaviour of baboons among the upper tributaries of the Nile is given by Sir S. Baker:—

"Troops of baboons are now exceedingly numerous, as, the country being entirely dried up, they are forced to the river for water, and the shady banks covered with berry-bearing shrubs induce them to remain. It is very amusing to watch these great male baboons stalking majestically along followed by a large herd of all ages, the mothers carrying their little ones upon their backs, the latter with a regular jockey-seat riding most comfortably, while at other times they relieve the monotony of the position by sprawling at full length and holding on by their mother's back hair. Suddenly a sharpeyed young ape discovers a bush well covered with berries, and his greedy munching being quickly observed, a general rush of youngsters takes place, and much squabbling for the best place ensues among the boys; this ends in great uproar, when down comes a great male, who cuffs one, pulls another by the hair, bites another on the hind-quarters just as he thinks he has escaped, drags back a would-be deserter by his tail and shakes him thoroughly, and thus he shortly restores order, preventing all further disputes by sitting under the bush and quietly enjoying the berries by himself."—*Nile Tributaries of Abyssinia*, chap. x.

The sensual and ill-natured beast in its most revolting aspect is chiefly exhibited to us in those baboons which have only a short erect stump in place of a tail, and among which the **Mandrill** (*C.* or *Mormon Maimon*), fig. 13, a native of the interior of Guinea, has been frequently, and the **Drill** (*M.* (*Cynocephalus*) *leucophæus*), a native of the same region, but seldom brought to Europe. Of their family life we know nothing beyond this, that they are very much dreaded by the negroes. In youth the mandrill is a highly likable and thoroughly comical fellow; when grown up he becomes ill-natured and treacherous, yet he has at times been completely tamed. He is specially distinguished by the striking colours of the naked parts and the singular form of the face. Even in the drill we can detect a slight swelling of the region between the eyes and nose. In the mandrill the cheek region is spongy and elevated, and marked with oblique furrows even on the young animal, and this form of feature becomes more marked with age. The head is large, the ridge on the crown covered with a stiff tuft of hair; the coat is olive-brown on the back, brighter on the under side, the moustache yellow, the ears black with a white spot behind. The high, swollen, and furrowed cheeks are sky-blue, the nose red, the large and swollen ischial callosities blue and red, the seat and the neighbouring parts bright red, and these parts the mandrill is fond of exhibiting to spectators as if he were proud of the colours.

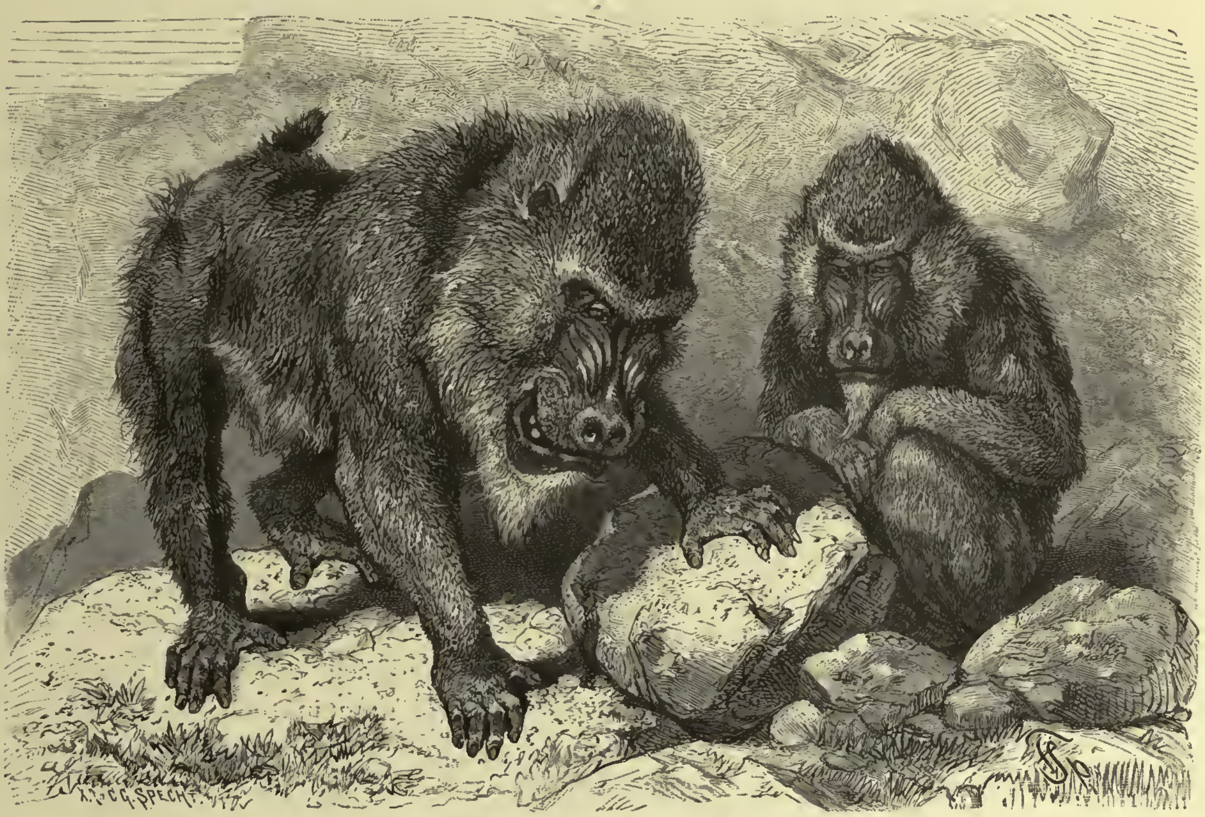


Fig. 13.—The Mandrill (*Cynocephalus Maimon*).

(B) THE MONKEYS OF THE NEW WORLD

(PLATYRRHINÆ).

With 36 teeth and broad nasal septum; the nostrils directed sidewards; ischial callosities and cheek-pouches always absent.

To the most essential distinguishing character of these monkeys, that which consists in the number of the teeth, attention was directed in the general account prefixed to the present section (p. 28), where it was pointed out that the New World monkeys have in each jaw one premolar more than those of the Old World, the number of the other teeth remaining the same.

But the American division is distinguished not only by the number but also by the structure of the teeth as well as of the jaws in general. While in the monkeys of the Old World, more especially in the large baboons, we could establish a decided tendency to the carnivorous type of jaws and dentition, we see here on the contrary a development from the lower and small species based on the type of the Insectivora, and that in so marked a manner that the lower jaw of a saimiri, for example, could scarcely be distinguished by the structure of its teeth from that of an insectivore. Although the canines are always more or less prominent and fit into opposite gaps, yet they never exhibit a dagger-like form and attain an excessive length, as we find them to do, for example, among the baboons. The tubercles of the molar teeth, in most species blunt and soon rubbed away by use, become indeed sharply pointed in the insect-eating species, but never acquire a cutting edge. The premolars, instead of being close set, are often far apart, and show the sharp conical form of the insectivores.

The muzzle is always short and only slightly protruding, never assuming that resemblance to the muzzle of a dog which is so characteristic of the baboons. The head appears far more rounded, the facial lies more under the cranial region, and the latter never has so well-marked crests and ridges as in the allied Old World monkeys. The whole form of the head is much more like that of man or rather like that of the young monkeys of the Old World. One might say with perfect justice that the head of the American monkeys is that of one of the Old World monkeys remaining fixed at the stage of childhood.

It is often difficult to detect the characteristic form of nose in the skull, since many New World monkeys exhibit quite as narrow a bony ridge in the nose as those of the Old World do. But in living animals one cannot fail to observe that the flat nose becomes broader in its cartilaginous parts, and that the nostrils are directed more sideways. Human-like rounded naked ears are never met with; for the most part the ears are thickly covered with hair and drawn out to a point above.

The form of the body varies. There are very slender and likewise somewhat plump figures among them, and the limbs are sometimes rather powerful, sometimes slim; but the limits of these variations are much narrower than in the Old World monkeys, and even if we leave out of account the much greater size of the latter, we never find in America such powerful frames as those of the baboons and the anthropoid apes.

Hands and feet are similarly formed. The fingers and toes always have flat nails. But while the great toe is always powerful and well-developed, the thumb is always weak, often rudimentary, and in the spider-monkeys it is altogether wanting as in the African Colobi.

The tail is never absent, but it is adapted by its structure to a considerable variety of functions. In some it is a prehensile organ, which is used exactly like a fifth hand for catching hold of the branches and enabling the monkeys to make their position secure, or even to suspend themselves from the trees; in others it is a sensitive tactile organ, the skin of the under surface of the extremity being in that case without hair. Among the Old World monkeys the tail never acts as an organ of prehension or touch, only as a rudder; but in many American monkeys the prehensile function is so highly developed, that even after death they remain suspended by the tail until the tension of the muscles is destroyed by the setting in of decomposition.

In accordance with the structure of tail and feet just described all American monkeys without exception are arboreal animals, which descend to the ground only occasionally for water, or to plunder a plantation, or to pass from one tree to another. Terrestrial monkeys in America there are none, and the treeless crests of the mountains have always constituted an impassable barrier limiting their distribution.

The external habits of life are thus much more uniform in America than in the Old World, and with few variations in detail all the monkeys of the New World live in a similar manner, in large troops, seldom alone or in small families; and their habitation is the tops of the trees of the primeval forests, where they move about with the same security and rapidity as other animals on the ground, and where they find abundance of food.

All observers agree in thinking that the American monkeys are mentally much less gifted than those of the Old World, and they appear to stand on a lower level than these also as regards the enjoyment of life. Their endowments are, indeed, quite sufficient for their requirements. They have cunning and intelligence enough to be able to procure their food, defend themselves against enemies, and shelter themselves from the inclemency of the weather; but the exuberant vivacity, the disposition to tease, the liability to sudden changes of mood which distinguish the Old World monkeys, are all qualities in which those of America are very deficient. Only a few of the sajous approach the guenons in the rapidity of their movements and constant restlessness; most of the others are extremely slow and cautious in climbing. The young play little; the old often sit for hours together with grave faces, as if sunk in melancholy reflections, and only on the approach of danger do they show by the rapidity of their flight the energy of which they are capable. Their disposition is peaceable, patient, confiding. Quarrels and fights very rarely disturb the harmony which prevails among the members of a band. Even old animals are easily tamed, although some only by the adoption of singular methods contrived by the Indians, among whom many species are kept as domestic animals, and that all the more readily since they become really affectionate in their ways, and the tendency to destroy is not very conspicuous in them. Although they are just as sincerely attached to their young, and tend them with the same care as the monkeys of the Old World, even (as is the rule with many species) dragging about two young ones with them for months after birth, yet one does not observe in them that bestial sensuality which gets the entire command of many of the Old World monkeys. Their inferior mental powers render them little adapted for drill, and while people are glad to see them in monkey-houses, and even on account of their gentle disposition in their own private houses, the owners of monkey-theatres can employ them at most only as mutes, never in leading roles. They are likewise wanting in the high courage, the defiant bravery in defence and attack, characteristic of some of the Old World monkeys, such qualities being displayed only occasionally on behalf of their young; they either flee or submit to their fate with silent patience. They have enemies enough in beasts of prey of all sorts, mammals, birds, and reptiles, especially serpents, and among their enemies we must not forget man. They have, indeed, nothing to fear from fire-arms; on the other hand they frequently fall victims to the arrows poisoned with curara blown from the blow-pipes of the Indians, to whom they afford a valuable booty on account of their flesh and fur. The slightest wound from a poisoned arrow, which the Indians are able to shoot to the height of a hundred feet, kills in a few minutes, and so paralyses the muscles that the monkey falls from the tree, while if he were killed by slugs or bullets he would in most cases remain hanging. The flesh of monkeys killed in this way is quite fit for food. Since the animal when wounded always draws the arrow out, the arrows are so made that the poisoned part breaks off and remains in the wound. By reducing the strength of the poison the Indians are able so to manage that the monkeys which they wish to have alive are momentarily paralysed, but after a time recover.

The American monkeys have been divided into several groups according to the structure of the tail.

NAKED-TAILED MONKEYS

(GYMNURÆ).

The long and powerful tail has at least the last third naked on the under surface, covered with rough skin, and serving as an organ of touch and prehension.

The uses of this tail, which has flattened vertebræ in the naked part, are manifold. Not only do these creatures suspend themselves by means of it, twisting it twice round branches, and then hanging free in the air swaying themselves backwards and forwards so as to increase the impetus with which they leap to rather distant branches, but they also use it as a hand to carry leaves and fruits to the mouth, and likewise as a highly sensitive organ of touch, the impressions of which do not require to be controlled by the other senses. Without using his eyes the creature, by means of his tail, acquires a knowledge of his surroundings, of the strength of branches, of the presence of eggs and other things, like a man feeling with his hands. The structure of the whole organ is of such a nature that it grasps and holds fast even in death.

All these animals are essentially leaf- and fruit-eaters, but do not despise eggs, young birds, and insects. Their molar teeth become so worn away with age, that the grinding surfaces become nearly smooth. The canines are short, triangular in section, and sharp at the edges.

The Howlers (*Mycetes*).

The monkeys belonging to this genus are the most persevering musicians of the primeval forests of South America, which they fill with the far-reaching sounds of their concerts, especially in the morning and evening. The larynx or upper part of the windpipe, where the voice is formed, is very wide, and the hyoid bone, which is usually a small bone supporting the back of the tongue, is swollen up into the form of a large resonant drum, and it is to these structures that the extraordinary music is due. The old males are the leaders in the concert; they sit opposite one another, as represented in fig. 14, and after a few beats the whole choir strikes in, but the concert at once ceases as soon as any danger approaches. They are ugly creatures, with plump body, thick neck mostly surrounded by a large beard, strong limbs, and well-developed thumbs. Their movements are slow and deliberate. In presence of danger they retire to the topmost branches of the trees, or into the recesses of the twining plants of the forest. The large climbing members of the cat tribe, the puma and ocelot, large serpents such as the anaconda, and man are their chief enemies; dogs pursue them with fury. On taking to flight they often let fall their excrements in their terror. The species shown in fig. 14, the **Red Howling Monkey** (*Mycetes seniculus*), has somewhat of the same colour as our squirrels. Old males acquire a golden yellow shimmer; the females and young are darker in colour. The fur is mostly very dense on the back. Several species are known.

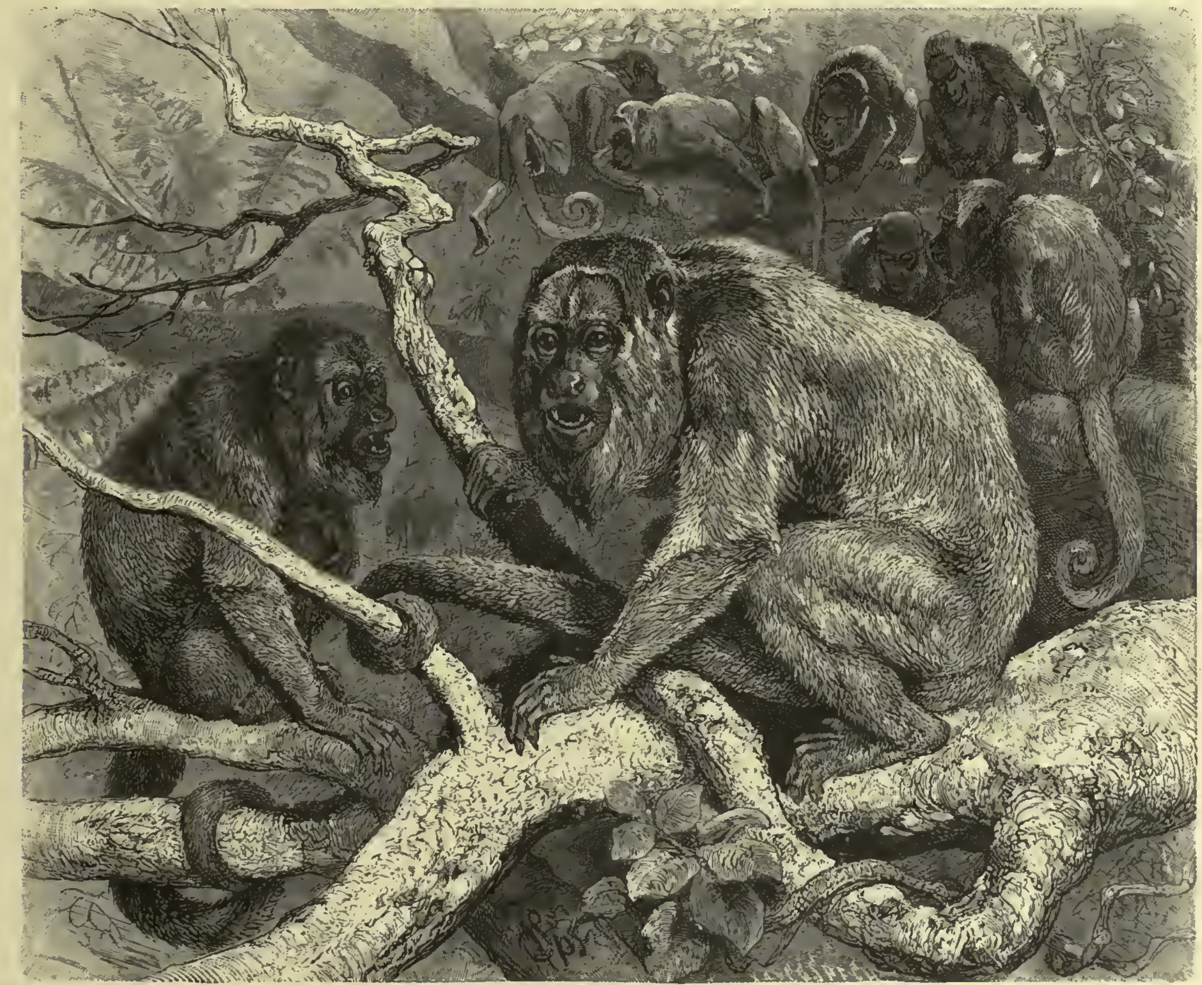


Fig. 14.—Red Howling Monkeys (*Mycetes seniculus*).

Le Vaillant, the naturalist and traveller, in the Introduction to his First Voyage tells the following story of a young red howling monkey (*M. seniculus*), such as is still called by the settlers in Guiana, as we are informed by Im Thurn, a baboon. It will be interesting to compare this account with that given by Wallace of the young mias. Le Vaillant, who was brought up in Dutch Guiana, where as a boy he was an enthusiastic collector of insects, had killed a mother. "As she carried on her back a young one which had not been wounded, we took them both along with us, and when we returned to the plantation my baboon had not quitted the shoulders of its mother. It clung so closely to her that I was obliged to have the assistance of a negro to disengage them, but scarcely was it separated from her, when, like a bird, it darted upon a wooden block that stood near covered with my father's wig, which it embraced with its fore-paws so firmly that I could not get it to quit its hold. Deceived by its instinct, it still imagined itself to be on the back of its mother, and under her protection. As it seemed perfectly at ease on the wig, I suffered it to remain, and fed it there from a sucking-bottle with goat's milk. It continued in its error for about three weeks, but after that period quitted the fostering wig, and by its amusing tricks became the friend and favourite of the whole family."

The fate of this "baboon" was even more pitiable than that of Wallace's young mias. Managing to get access to the young entomologist's collection he began to devour the insects, pins and all, and in consequence perished in agony.

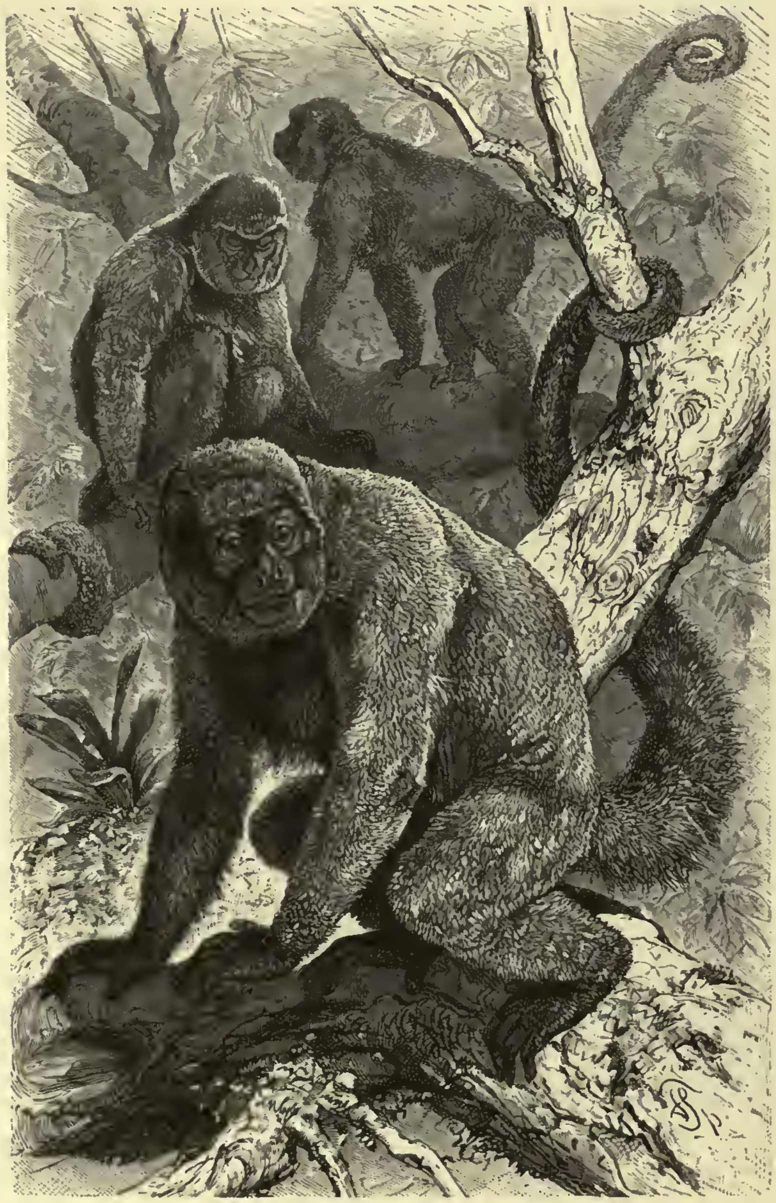


Fig. 15.—The Barrigudo (*Lagothrix Humboldti*)

The Woolly Monkeys (*Lagothrix*).

The *Lagothrix Humboldti*, the **Barrigudo** of the natives, fig. 15, approaches the howling monkeys in size (about 28 inches without the tail) and the general shape of its thickset body. But it lacks the well-developed vocal apparatus of these creatures, merely emitting a monotonous subdued howl, which is not heard at any great distance. The fur is very dense and woolly, especially on the back. In a state of freedom it is described by all as slow and deliberate in its movements; but as to its disposition, while by some it is spoken of as good-humoured and gentle, by others it is denounced as ill-natured, intrusive, and apt to bite. It is even said to attack the Indians by throwing branches of trees and fruits at them. The observations made on captive specimens agree rather with the representations of the former. When wounded they fall from the trees, but defend themselves, especially when they can reach the trunk of a tree, in the most determined manner with their teeth and hands, all the fingers on which (though not the thumbs) are armed with curved pointed nails. At the same time they call their comrades to their aid by a peculiar shrill cry, while the more subdued cry of death urges the latter to rapid flight. The dense fur of the species in our illustration, a covering absent, however, from the abdomen and loins, is slate-gray, but darker on the back.

The Spider-monkeys (*Ateles*).

The members of this genus correspond in the slenderness of their body, length and thinness of the limbs, and the rudimentary character or entire absence of the thumb, to the African Colobi. The species shown in fig. 16 is the **Miriki** (*A. eriodes*), which has a dense woolly fawn-coloured fur, and a rudimentary thumb without a nail. The above described functions of the tail are developed in the spider-monkeys, of which several species are known, to the very highest degree: the movements of these creatures and the positions which with the aid of their tail they can assume are the most singular. They are often hunted for their fur and flesh, and when pursued they seek to make their escape through the tree-tops with the utmost rapidity, always sending out their tail in advance so as to make sure of their hold. Gentle and amiable in captivity they have an extremely droll appearance, on account of the contrast between their comical attitudes and the grimly melancholy expression of their countenance.

THE SAJOUS

(CEBIDÆ).

Tail long and strong, completely covered with hair, and serving only as a prehensile organ, not as an organ of touch.

The tail has flattened vertebræ at the end as in the Gymnuræ, but no naked parts. It is used as a means of making the creature secure in its position and as an aid in climbing, but only seldom to hang by and never to touch or seize food by. In form and behaviour these creatures have most resemblance to the Cercopitheci. While awake they are constantly in motion, capricious, intelligent, sly and cunning, given to teasing, even somewhat malicious, very ready to associate not only with man but also with other animals, but as a rule capable of learning only what is of use to themselves, not so easily taught to perform tricks. The fur is short and thick, and often peculiar adornments in the shape of beard, whiskers, and tufts of hair are to be seen about the head and face. The face is naked, mostly also marked with wrinkles and folds, which gives them a dismal appearance, all the more apt to excite pity since they have a childish whining voice, on which account they are sometimes called the whining monkeys. In terror and anger the voice becomes extremely harsh, but besides the notes of fear and rage they have a whole register of notes at their command to summon their comrades or mates, to warn, and to serve other purposes. Their movements are dexterous, graceful, and rapid, although not so lively as in the guenons. When fleeing they regularly make their way through the tops of the high trees, from which they descend only to plunder fields or to drink. Their food is indeed in great part vegetable, but they are very expert in the catching of insects and small birds, and do not let slip any opportunity of regaling themselves with dainties of that sort. These creatures also are frequently hunted by the Indians for their flesh and fur, but are extremely shy, and as a rule can only be surprised with the blow-pipe from some carefully contrived place of concealment.

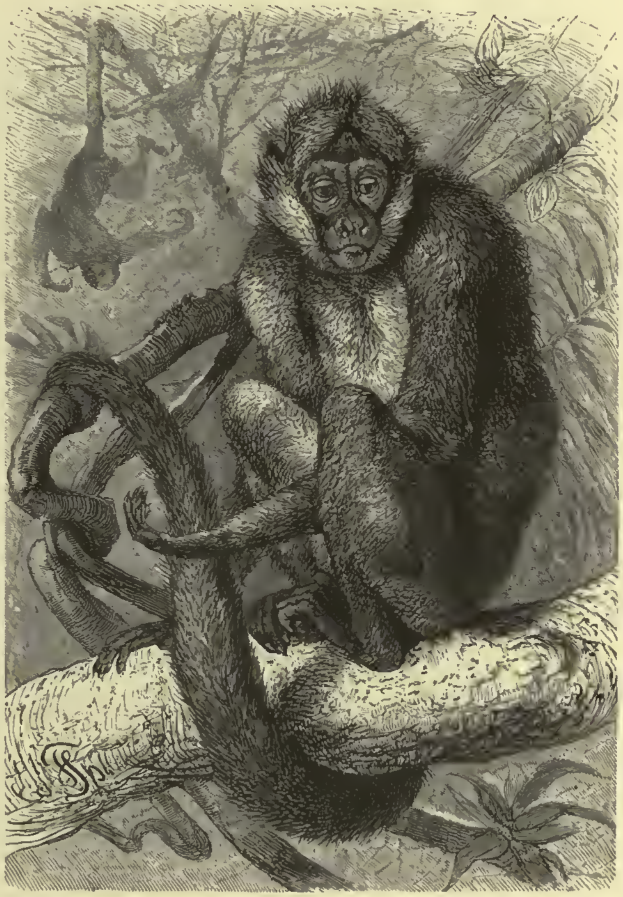


Fig. 16.—The Miriki Spider-monkey (*Ateles eriodes*).

The single genus Cebus forms the entire

group, and one may perhaps say that there is no other genus in the animal kingdom which appears to be so much in a state of flux, in which the species are marked off from one another by characters so ill-defined, and the varieties in colour, arrangement of the hair, &c., are so numerous. Whether this variation depends on frequent hybridization, or on the fact that the species in a certain measure are still in the process of being formed and are not yet sufficiently well fixed, is still an unsolved problem. The species represented in fig. 17 is the **Weeper Capuchin** or Sai (*Cebus capucinus*), above whose wrinkled, naked, flesh-coloured forehead the short thick hair forms a kind of cap. The fur is brown, darker on the back.

The different species of sajous are almost always to be met with in the huts of the Indians as domestic animals, and are brought over to Europe in great numbers. Their dirty habits are a still greater objection than their disposition to tease other animals. They usually discharge their urine into their hands and then rub their bodies with it; and so also when they get hold of snuff or any other pungent-smelling article they at once proceed to rub it all over their bodies. The shrewd creatures probably do this principally in order to rid themselves of the disagreeable parasites that infest their coats. In the monkey-houses they are mostly tyrannized over and ill-treated by the Old World forms, unless they manage by their pitiful whining and caressing to gain the favour of a larger monkey who protects them.

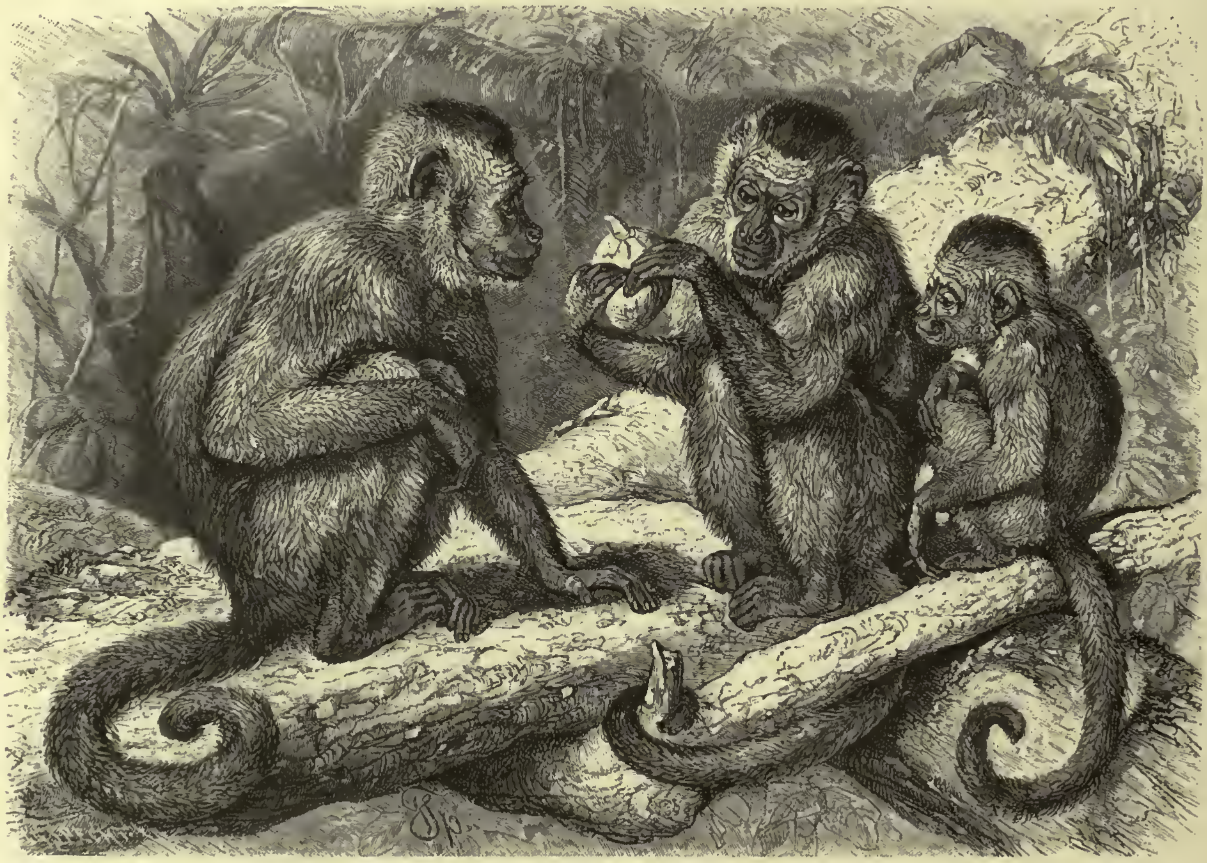


Fig. 17.—The Weeper Capuchin or Sai (*Cebus capucinus*).

THE SAKIS

(ANETURÆ).

With tail of various length, with vertebræ becoming thinner and thinner towards the end; the tail never used for grasping.

A group rich in genera, in whose dentition a regular descending transition towards the insectivorous type can be made out, a transition manifested by the canines becoming thinner, the premolars further apart, and the tubercles on the molars more pointed. This character and the increasing curvature of the finger-nails make these mostly small monkeys a connecting link with the Clawed Monkeys, from which, however, they all diverge in the number of their teeth. Many of them are almost entirely insect-eaters, and they are able to catch in leaping the booty that may have escaped from between their fingers. The tail varies in length from a short stump to one greatly exceeding the length of the body; but this organ serves only as a rudder or to wrap round the upper part of the body and neck in sleep, or as a protection against cold and wind.

The **Sakis** proper (*Pithecia*) agree with the members of the last genus in the possession of short triangular canines, with sharp cutting edges before and behind, and blunt tubercled molars, but present some resemblance to certain prosimians in the form and mode of insertion of the incisors (which, especially in the lower jaw, are strongly inclined forwards), and in the pointed conical form of the premolars. The fur is not very thick, but is composed of long hair, which gives the creatures a plump appearance. The hair of the head is long, and parted in the middle, and at the sides is continuous with the whiskers and beard, which are often very large. The hairy covering of the long tail becomes longer and longer towards the end, so that it resembles that of a fox. The movements of these creatures are sluggish and sleepy, yet they can catch insects and birds very well in leaping. Small and timid, they mostly congregate in companies hidden in the recesses of the trees apart from the other monkeys, which ill-use them. They inhabit especially the region of the Orinoco and the Amazon, and when caught young become very tame and much attached to their owners; but they are only seldom brought to Europe, where they do not survive long. The **Couxio** or Black Saki (*Pithecia Satanas*), represented in fig. 18, is distinguished from some allied species by its uniform black colour, and the large and long beard.

Near these stand the short-tailed monkeys (*Brachyurus*) with a dentition exactly similar, but with a short stump-like tail, very wide nostrils placed sidewards, and claw-like curved nails on all the fingers and toes except the thumb and great toe. The hair on the body is still longer than in the previous genus, and is mostly of a colour resembling that of withered grass; on the tail the hair is very thick. The face is mostly scarlet in colour, as is the case, for example, with the **Ouakari** (*Brachyurus calvus* (*ouakari*)), represented in fig. 19, a species of monkey met with in a few isolated areas of small extent on the Parana and the Japura, especially in forests that are inundated during the greater part of the year. For that reason, as well as on account of the rarity of its occurrence, the capture of a monkey of this species is re-

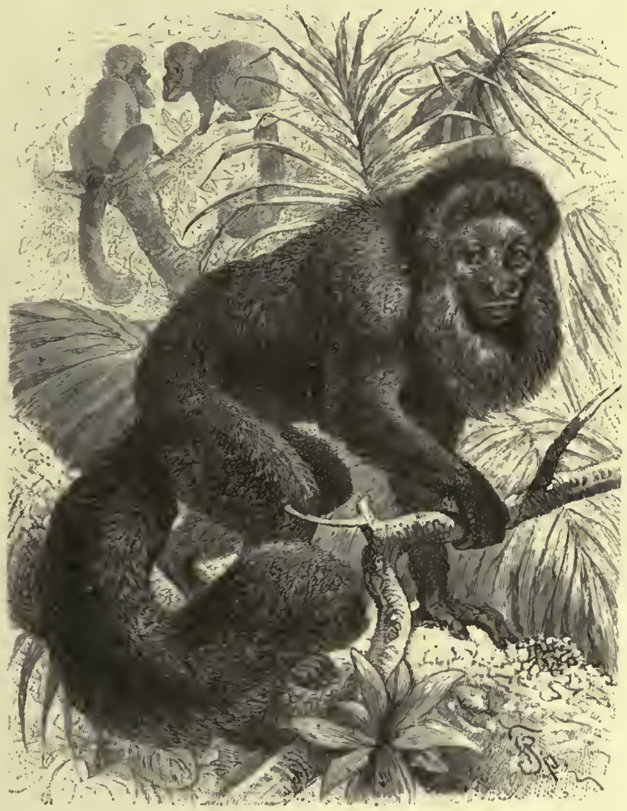


Fig. 18.—The Couxio or Black Saki (*Pithecia Satanas*).

garded as exceptionally difficult, and the present of a living specimen, obtained by means of a slightly poisoned arrow blown from the blow-pipe, is considered one of the most valuable that an Indian can make. The fur is reddish-yellow, darker on the under side, the fillet above the eyes bright yellow. These creatures are very silent, are said to move about among the branches with great agility, seldom leaping, however. When caught young they are easily tamed, and become attached to their owners, but they do not survive long.

The members of another genus of monkeys living only in moist forests, and soon perishing in drier climates, are pursued by the Indians with the utmost eagerness, partly for the sake of their flesh, partly to be kept as domestic animals. These are the **Tee-tees,** forming the genus Callithrix. The chase is greatly facilitated by the loud voice of the little animals, a voice little inferior to that of the howling monkeys, and which owes its strength to an enlarged drum-shaped larynx. The fur is long and coarse, the long tail furnished with a uniform covering of hair. In the species represented in fig. 20, the **Masked Callithrix,** the Sasnassu of the Indians (*Callithrix personata*), the body of which is about 16, the tail 20 inches in length, the colouring is somewhat variegated. Hands, head, face, and throat are black, the long hair on the back reddish-brown, the tail a rather light gray, especially on the under surface. The male has a white band on the back of the neck. The dentition of the tee-tees resembles that of the Clawed Monkeys. The canines are small, and the tubercles of the molars are connected by transverse ridges. The movements of these creatures are very lively and elegant. Their food consists essentially of insects and other small animals, which they are very expert in catching while leaping. They live only in small troops or families, are always

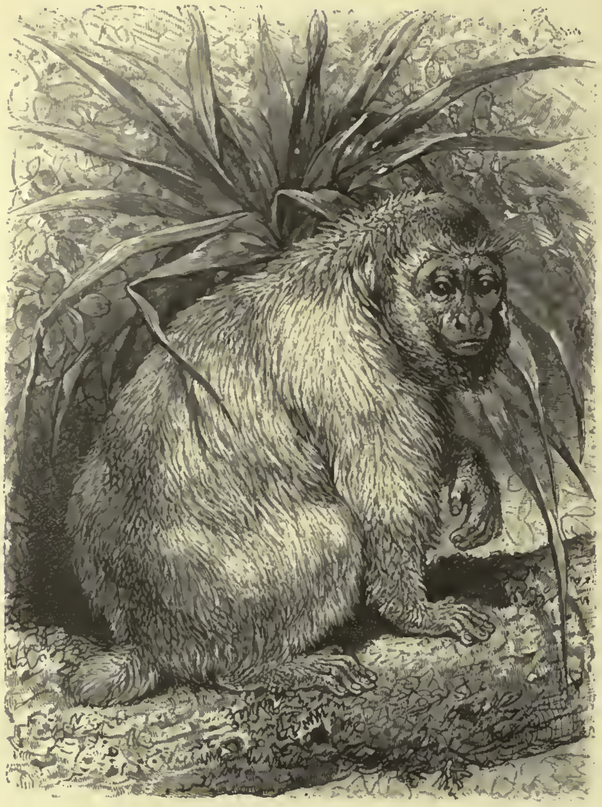


Fig. 19.—The Ouakari (*Brachyurus calvus*). page 67.

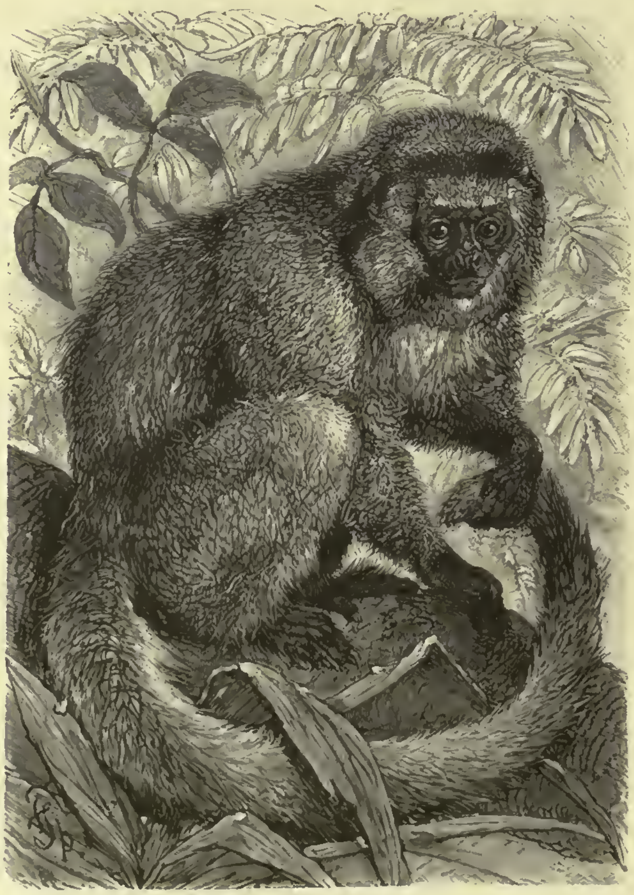


Fig. 20.—The Masked Callithrix or Sasnassu (*Callithrix personata*).

gentle and good-natured, and purr like cats when they feel themselves comfortable, which, however, is scarcely ever the case in Europe. About seven different species are known.

The **Saimiri** or Squirrel-monkey (*Chrysothrix sciurea* or *Pithesciurus sciureus*), fig. 21, which is found living in large herds in Guiana, is distinguished from the former by the prominent, sharp, curved canines, the large middle incisors in the upper jaw, and the premolars and molars of nearly the same form. Elegant, slender, active, graceful in climbing, and excellent at leaping, the saimiri is at the same time extremely shy and timid, and very sensitive to cold. It is fond of low bushes, but on the approach of danger at once seeks refuge with great celerity in the high trees; and it spends the night mostly amidst the crown of leaves at the top of palms. It uses its long tail partly as a rudder, but also for warming itself, wrapping it for that purpose round its neck. When the weather is rather cold for them, the members of a company crouch together in a ball or in several balls covering each other with their tails; and the Indians generally take advantage of the opportunity which this practice affords to catch old animals for food and young ones to tame. In a state of freedom they often shiver, cry, and whine for cold and rain, and their cry of terror in presence of beasts of prey serves as a warning to other animals. They live chiefly on insects and small birds, but also eat fruits and juicy buds. The fur in young animals is of a dark brownish-red; but in old males is often orange-yellow on the back, rusty on the limbs, while the muffle and tip of the tail are black. Yet there are many varieties in colour. The nails are arched and claw-like, the thumb only slightly developed. These extremely amiable creatures, which are often kept as domestic animals, and serve to cleanse the huts of the Indians from all kinds of minute vermin, though they appear to prefer spiders, attain a size of 15 inches at most.

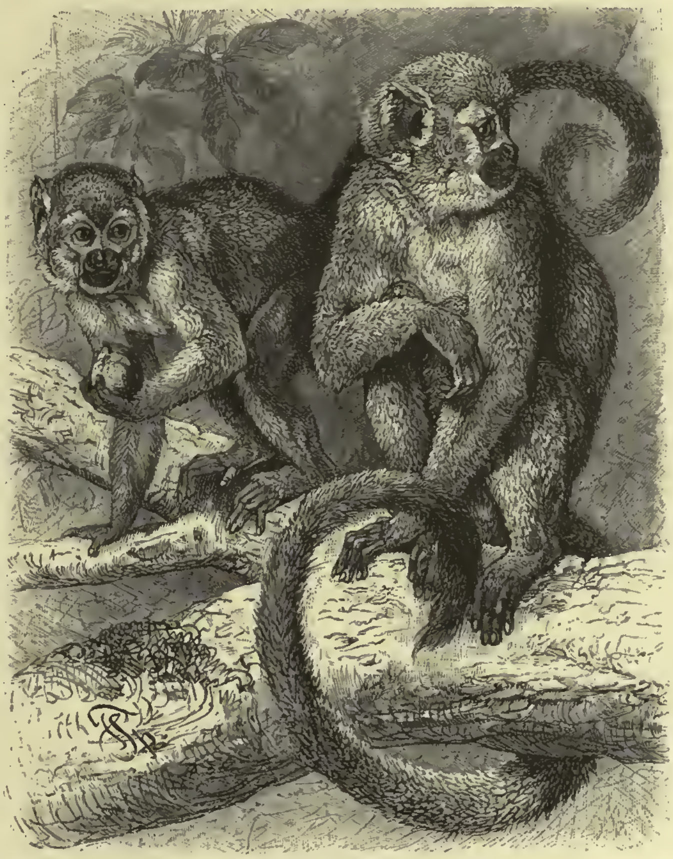


Fig. 21.—The Saimiri or Squirrel-monkey (*Chrysothrix sciurea*).

A peculiar type, with which we close our series of true American monkeys, is represented by the genus Nyctipithecus, of which several species are known. The dentition, and the structure of the tail, hands, and feet are like those of the saimiri, but the body is more thickset. The ears are very small, the eyes very large and so close to one another that only a narrow bridge of the nose remains between. The legs are much longer than the arms.

Entirely nocturnal in their habits these animals, whose range of distribution in South America is tolerably wide, sleep during the day in pairs, seldom in larger companies, in holes in trees, which they line with moss and feathers to keep them warm. But their sleep is not so profound that they are not awakened by noises, their sense of hearing being apparently very highly developed in spite of the fact that they have only small ears almost hidden in the fur. In the light of day they are, as it were, oppressed with drowsiness, and are sulky, ready to bite, and helpless; but by night they become cheerful and active, climbing and jumping about with great dexterity in search of their prey, which consists exclusively of insects and birds. The favourite parts in the latter are the brain and the entrails. Their large eyes shine more conspicuously than those of cats. The species represented in fig. 22, the **Mirikina** or Three-banded Douroucouli (*Nyctipithecus trivirgatus*), is gray above, orange-yellow on the under side, and is distinguished by three black stripes on the forehead, the middle stripe running down to the ridge of the nose, the other two to the outer angle of the eyes. The fur is thick and soft. This monkey has been met with from Paraguay to Guiana. It is seldom brought to Europe, has but little intelligence, and exhibits no attachment to its keepers, but appears to be good-natured.

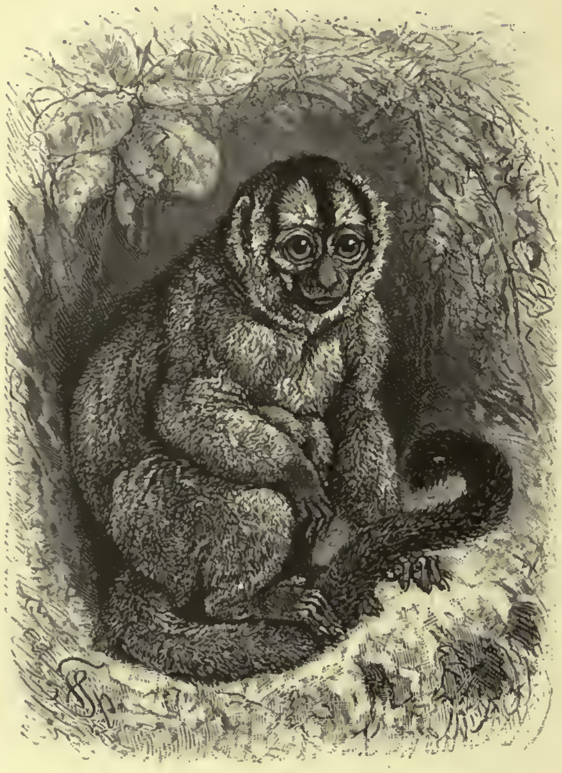


Fig. 22.—The Mirikina or Three-banded Douroucouli (*Nyctipithecus trivirgatus*).

(C) CLAWED MONKEYS

(ARCTOPITHECI).

With 32 teeth, fore-paws without an opposable thumb, but hind-feet with an opposable hallux, all the digits except the hallux provided with claws.

The nature of the dentition has already been explained in the general account of the Simiæ. The Arctopitheci have three premolars like the other American monkeys, but they have only two molars, the posterior of which is besides always very small. Although, accordingly, the number of the teeth is the same as that of the Old World monkeys and of man, yet the fundamental type is essentially different, and when recent authors assert that in respect of their dentition they approach the Old World monkeys more nearly than their fellows belonging to the same continent, they do so only on the basis of a superficial comparison.

The dentition is a purely insectivorous one, and has much resemblance to that of the saimiri. The chisel-shaped incisors have a marked inclination forwards, especially in the upper jaw, in which, moreover, the inner ones are the largest. A relatively large gap separates them from the sharp prominent recurved canines. The premolars in addition to the sharp middle point have lateral cusps, the molars are sharply indented and are provided with a narrow internal heel or process. The forehead, as in the saimiri, is very flat, and the brain-case is oval, the broad part behind. The vertebral column is exactly that of a mammalian quadruped. The tail is always very long, and is carried in a hanging position.

The fore-limbs are paws with sharp claws on the digits; the thumb is non-opposable. In the hind-limbs, on the other hand, the hallux, which, to be sure, is only slightly developed and by no means a "great toe," is opposable, but has a flat nail, while the other four toes, like all the digits of the fore-limbs, have sharp curved claws.

The Arctopitheci comprise about twenty known species, which, though differing from each other sometimes rather strikingly in the character of their hair-covering, present otherwise such slight divergences that they are all referred to one genus, Hapale.[1] Their range extends northwards into Mexico.

They live socially not only in the primeval forests but also in sparse clumps containing lofty trees, and their whole behaviour resembles that of our squirrels. They pass the night sometimes in pairs, but sometimes also in companies in hollow trees, which they line internally with moss and leaves, and they always choose hollows with narrow entrances, in order to protect themselves as far as possible from the marten-like beasts of prey which, as well as serpents and rapacious birds, eagerly seek after them. Like our squirrels they jump but seldom, and in hasty flight from one tree-top to another prefer to run down the stem of the one tree and then, hastily crossing the interval between the two on the ground, clamber up the other. If they happen to be observed in climbing a tree they know how to hide themselves dexterously behind the trunk of the tree or behind its larger branches.

They are extremely shy, timid little creatures. Their body is at most one foot in length. Unlike other monkeys they produce two or three young at a birth, and these the female drags about with her, or, when she becomes tired, hangs on to the male, who then behaves towards them in a quite maternal manner. If it must be admitted that they show great skill in moving about and providing for their own safety, that is about all that can be said of their mental qualities. Their food consists almost exclusively of small animals, insects, spiders, &c., and sweet vegetable substances are eaten only as a relish.

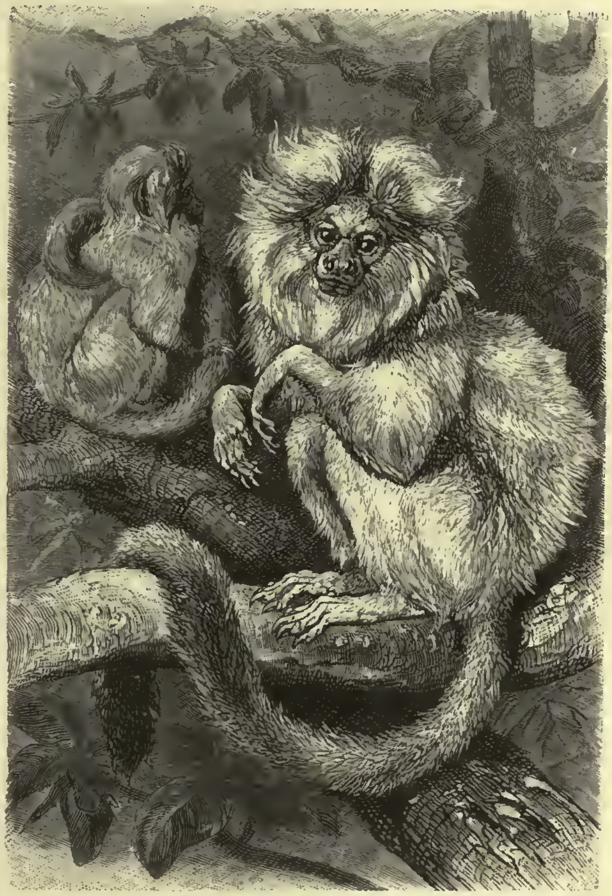


Fig. 23.—The Silky Marmoset (*Hapale rosalia*). page 72.

Some species are very frequently brought to Europe and tended as in their native land. But it is only very slowly and with much difficulty that they learn to know their

---

[1] Sometimes they are divided into two genera, Hapale and Midas.—Tr.

LIBRARY OF THE UNIVERSITY OF CALIFORNIA

keepers and allow themselves to be caressed and warmed by them; and they are very disagreeable guests from their filthy habits and on account of the putrid musky odour which their urine, scattered all about, diffuses round their cage. So far I have observed only in Russian ladies a sometimes excessive fondness for these elegant and pretty stinkards.

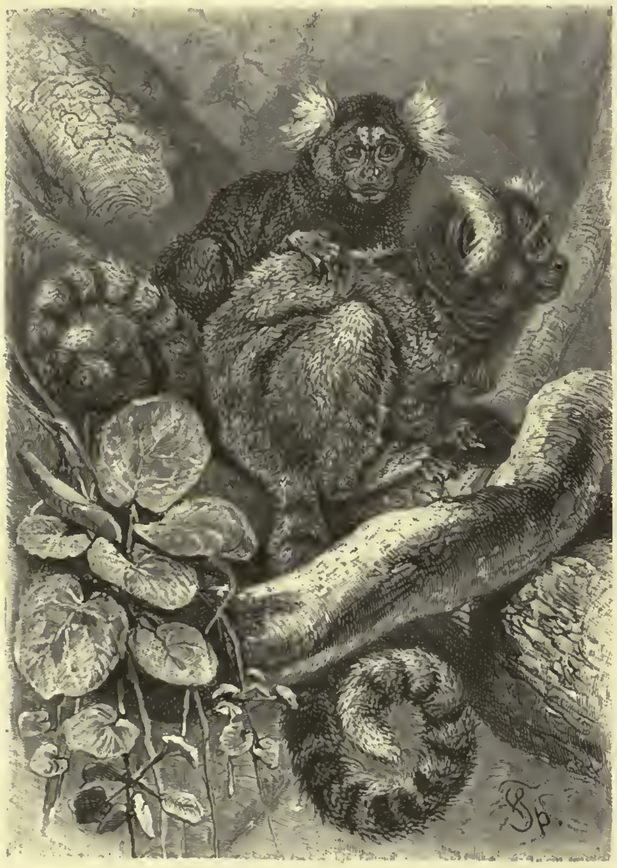


Fig. 24.—The Ouistiti or Common Marmoset (*Hapale Jacchus*).

The voice is a tremulous piping, which in anger becomes a scream, almost like the half-suppressed cry of a sucking infant. Some species, perhaps all, sing in a state of freedom when they think themselves quite unobserved and secure, their notes, according to the accounts of hearers, being like the twittering of birds with flute tones intermingled.

The fur on the body is mostly woolly, and at various parts the hair is often lengthened into tufts, manes, and thick brushes. The tail is always very long, sometimes with a terminal tuft, sometimes more uniformly bushy.

Among the Clawed Monkeys which have been brought to us is the **Silky Marmoset**, fig. 23 (*Hapale* (*Midas*) *rosalia*), with brown back and brown stripe on the crown of the head, reddish-yellow fur, and gray-brown naked face. Head and neck are surrounded by a mane like that of a lion, which can be erected when the creature is angry. The tail has longer hair towards the extremity, but no proper tuft.

Of the intelligence of this and an allied species Bates speaks very emphatically. "In Para," he writes, "*Midas ursulus* is often seen in a tame state in the houses of the inhabitants. When full grown it is about nine inches long, independently of the tail, which measures fifteen inches. The fur is thick, and black in colour, with the exception of a reddish-brown streak down the middle of the back. . . . Anatomists who have dissected species of Midas tell us that the brain is of a very low type, as far as the absence of convolutions goes, the surface being as smooth as that of a squirrel's. I should conclude at once that this character is an unsafe guide in judging of the mental qualities of these animals; in mobility of expression of countenance, intelligence, and general manners these small monkeys resemble the higher apes far more than they do any rodent animal with which I am acquainted.

On the Upper Amazons I once saw a tame individual of the *Midas leoninus* [=*Hapale* or *Midas rosalia*], a species first described by Humboldt, which was still more playful and intelligent than the one just described. This rare and beautiful little monkey is only seven inches in length, exclusive of the tail. It is named *leoninus* on account of the long brown mane which depends from the neck, and which gives it very much the appearance of a diminutive lion. In the house where it was kept it was familiar with every one; its greatest pleasure seemed to be to climb about the bodies of different persons who entered. The first time I went in it ran across the room straightway to the chair on which I had sat down, and climbed up to my shoulder; arrived there, it turned round and looked into my face, showing its little teeth, and chattering, as though it would say, 'Well, and how do *you* do?' It showed more affection towards its master than toward strangers, and would climb up to his head a dozen times in the course of an hour, making a great show every time of searching there for certain animalcula."—Bates, *The Naturalist on the River Amazons*, vol. i. chap. iii.

The species most frequently to be seen among us are the bushy-eared monkeys, known under the name of **Ouistiti** or Common Marmosets. Fig. 24 represents the commonest of the species so called (*Hapale Jacchus*). This little creature attains at most a length of 9½ inches, while the thick-haired tail with dark rings is about one-third longer. The distinguishing character of these animals consists in stiff tufts of hair in front of the ears, these tufts being mostly divided into three parts, and generally of a bright colour. In the species represented these tufts are white, while the body has a grayish or dark slate-colour.

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE APES AND MONKEYS.

The geographical distribution of apes and monkeys presents many remarkable peculiarities worthy of a closer consideration.

With few exceptions, belonging chiefly to the Semnopitheci and the Cynocephali, found on the high mountains of Asia and Africa, even in some cases on the edge of the snow-line, all monkeys are to be found within the tropical and subtropical zone in which palm-trees flourish. The palms have even a wider area of distribution in latitude, for while the magot is indeed settled on European soil in company with the dwarf-palm of the Mediterranean region, monkeys are altogether wanting in the palmetto regions of Texas and Louisiana. On Madagascar and the Antilles also monkeys do not occur, although these islands are rich in palms. As regards elevation, however, monkeys have the advantage, for in the Himalayas and in Northern Tibet monkeys are met with even in the pine forests of the higher regions, which are covered with snow for months together.

This law of confinement to tropical and subtropical climates appears to have been universally valid also in former geological epochs. The primitive monkeys pressed much farther northwards, but during epochs when palms also extended to the shores of the Baltic and the south coast of England. When the Thames flowed in regions whose climate, to judge from the plants found in them, resembled that of the region intersected by the mouths of the Ganges, monkeys occurred even in the latitude of London. The largest and most human-like monkeys are found only in the hottest regions of the Old World, and an ancestor of these, the **Dryopithecus**, lived in southern France during the Miocene period as member of a fauna analogous to that of the torrid zone in the present age.

Of special importance is the sharp separation between the monkeys of the Old and the New World, those of the Indo-African tropics on the one side, and those of the South American tropics on the other, a separation which is unequivocally expressed in the zoological characters, and culminates in this, that the Simiæ of the Old World, by the structure of their nose and teeth, as well as by their adaptation to more varied conditions of life, have unquestionably attained in their branches a higher stage than their American kindred. All the American Platyrrhines with 36 teeth, and all the Clawed Monkeys, are arboreal forms, and so much dependent on the existence of forests that they have neither crossed the Cordilleras nor extended to the Antilles, which, nevertheless, were probably connected in former times with the mainland, though, no doubt, only by means of treeless isthmuses. Most of the American Simiæ have never come down to the earth. They have been born in the tops of the trees of the primeval forest, there have lived, and have ended their existence still hanging in death to the branches.

Now although the majority of Old World Simiæ, which have all the same dental formula as man, live entirely among trees, even some of the anthropoid apes, like the orangs and gibbons, still leading such a life exclusively, yet we see many adaptations to other conditions of life. One may characterize the chimpanzee and gorilla as well as the magot as semi-arboreal forms. They sleep on the trees, seek their nourishment partly in their fruits, but remain just as much upon the ground, where the former, at least, assume a semi-erect position, and frequently, especially in fighting, go upon only two feet. As entirely terrestrial forms we may designate the *Macacus nemestrinus* and all the baboons, for, while they are able to clamber about dexterously among the rocks on all fours, and seek their nourishment, for the most part, only on the ground, and, indeed, even in the earth, they climb high trees but seldom, and most of them prefer to frequent districts quite destitute of trees. That high mountains rising above the tree-line can form no barrier to the distribution of terrestrial monkeys, as it does to those of America, follows as a matter of course.

Yet the arboreal life seems even in the Old World to have exercised an important influence on the geographical distribution, for all the arboreal forms of the Old World are confined to their respective continents and island groups. The members of the genus Troglodytes (chimpanzee and gorilla), the Colobi, and Cercopitheci are all restricted to Africa; the mias, gibbons, and Semnopitheci are found only in the Asiatic tropics; the macaques are an Asiatic type, of which only one species, the magot, has spread westwards along the borders of the Mediterranean. The baboons, on the other hand, in spite of their extension to Arabia, and in spite of the occurrence of the black ape on the islands of the Eastern Archipelago as far as Celebes, appear to be an essentially African type. But these two genera, the macaques, and still more the baboons, distributed over both continents, are precisely the two which have more and more abandoned arboreal habits of life.

Although sufficient evidence is forthcoming to show that even at the present day the various families of monkeys undertake migrations, which are chiefly determined by the want of food, and some species manifestly lead a nomadic and vagabond life, yet these migrations must be confined within pretty narrow limits, and afford no explanation of the striking distance of the black ape on the one hand, and the magot on the other hand from their present centres.

To explain these facts, as well as the absolute geographical separation of the Simiæ of the two hemispheres, and the absence of all true monkeys on Madagascar and the Antilles, we must recognize other causes as the determining factors, and these we can find only in tracing the origin of the different forms.

We now know, mostly, to be sure, only through fragments of jaws containing teeth, a considerable number of fossil Indo-European and some few American monkeys. The species belonging to the older Tertiary strata, the Eocene, are doubtful, and it is only the Middle and Upper Tertiaries as well as the cave- and alluvial deposits that have yielded undoubted simian remains.

On a closer analysis of these fossil forms the first result that is established as an indubitable fact is, that the separation of types according to hemispheres, as it now exists, was indicated from the first: all the fossil remains of Simiæ hitherto found in the strata of the Old World belong to the Catarrhines with 32 teeth; all the New World bones, on the other hand, to Platyrrhines with 36 teeth. From the beginning of the Miocene, and probably even earlier, the two hemispheres were accordingly at least so far separated that no transmigrations of monkeys could take place. Similarly the absence of monkeys on Madagascar proves that that large African island has been separated from the mainland since monkeys have existed, while, on the other hand, the close agreement between the monkeys of the Sunda Islands and those of the neighbouring part of the Asiatic continent must force on us the conviction that these lands, now separated by arms of the sea, must have been in connection with one another down to comparatively recent geological epochs. The two simian stems, that of the Old World and that of the New, must accordingly have developed in isolation from one another, and cannot be traced back to a common root.

We have already mentioned that, in accordance with the extension of warm climates towards the north, to which the vegetable world bears witness, the areas of distribution of monkeys also extended northwards into what is now Temperate Europe and the north of the present United States. Judging from the abundant remains that have been discovered, especially at Pikermi in Greece and Sansans at the foot of the Pyrenees, as well as in Italy, we may conclude that in the later Miocene period the belt bordering the Mediterranean on the north must have been inhabited by just as numerous herds of monkeys of various species as the wooded regions of the tropics in the interior of the continents now are.

Some facts appear to indicate that the extinct monkeys of the Mediterranean region belong more to the types now found in Asia, and exhibit characters combined which at the present day are seen distinct and in a more pronounced form in individual families and genera. Thus, as Gaudry has shown, the monkey which has left behind such abundant remains at Pikermi (Mesopithecus) is a Semnopithecus as regards the structure of its head and the form of its teeth, while on the contrary the bones of the body would cause us to refer it to the macaques. This mixture of characters, which afterwards became more and more fixed so as to mark off different divisions more sharply, is a phenomenon of very common occurrence, which we shall frequently, and indeed almost universally, meet with hereafter in the various orders of the Mammalia. The older type is neither macaque nor Semnopithecus, but possesses certain characters of both; only in the present geological epoch have these characters become so pronounced as to characterize different genera. One can trace the magot from this separation.

But this again is the only circumstance that could be adduced in the case of the Simiæ as favouring the idea of a gradually advancing development of the types. If we consider the present Old World forms as regards their divisions, Semnopitheci, Cercopitheci, and Colobi might be taken as forming the leading types for both continents, all these being purely arboreal forms, intelligent climbers, typical monkeys in every respect. In the macaques on the one hand, and the baboons on the other hand, we find adaptations to a terrestrial mode of life represented, in the gibbons and the other Anthropomorphæ higher developments towards the human type. Attention has already been drawn to the fact that these anthropoid apes ascend towards the human type in different directions, that accordingly, as I have already clearly shown a considerable time ago, no single line of ascent to the human type can be demonstrated; that the gorilla stands nearer to man than its rivals in respect of the structure of its extremities, the orang as regards that of the brain, the chimpanzee that of the head and teeth. The assertion of a single line of development leading up to man finds accordingly no support whatever in facts from an analysis of the Simiæ of the present day.

And just as little support does it find in the consideration of the fossil forms. With the exception of the above-mentioned sharper fixation of characters, which, however, have nothing to do with the question of resemblance to man, and accordingly with a higher development especially of the brain, we can adduce not a single fact in favour of the idea that during the different periods in the history of the earth's crust the type of the Simiæ has made steady advances to a higher state of development. The large anthropoid ape found at Sansans, the *Dryopithecus Fontanæ*, of which, it must be mentioned, we possess only an incomplete lower jaw, stands as near to man as any of the still living Anthropomorphæ, if not nearer. In South America there were even found remains of a large ape (Laopithecus) which stands nearer to man than all the American monkeys of the present time. The Miocene period has accordingly brought the Simian type as far, has developed it to as great a height, as our present world. In respect of organic perfection this type has stood still since the later Miocene period.

It must be admitted, however, that if, in accordance with the principles of the now received evolution theory, we take into account the development of the individual, we have to meet the significant fact, that the infant ape is in every respect nearer the child of the human species than the adult ape is to an adult man. The original distinctions of the young of both types are much more insignificant than those of adult individuals. This assertion long ago made by me in my "Lectures upon Man" has received striking confirmation from the more recent investigations on the young Anthropomorphæ which have died in European zoological gardens. The older the individual becomes the more pronounced become the characteristic distinctions in the form of the jaws, the occipital crests, &c. Man and ape, as they develop from the embryonic condition and the young form, diverge indeed almost in opposite directions towards the final type of their genus; but even adult apes always retain in their organization traits which correspond to those of the human infant.

From these facts we may draw the conclusion that man cannot stand in genetic relation either to any of the present apes or to any of the fossil forms yet discovered, but that both types have originated from a common form which is more clearly expressed at the stage of infancy, because the period of childhood is more closely approximated to it.

The question whether the true apes and monkeys, or in one word the Simiæ, can be brought into genetic connection with the Prosimii will be discussed in treating of the latter.

By way of resumé we may say that the Simiæ, so far as they are known to us, have been from their first appearance on the stage of life arboreal forms adapted to a tropical climate, forms moreover which have always been strictly limited to the hemispheres now assigned to them, but which in earlier geological epochs spread farther to the north within these hemispheres, and that in neither hemisphere do they exhibit any essential advance in organization since the Miocene period.

THE PROSIMIANS

(PROSIMII).

Climbing animals, with complete dentition, opposable thumb and great-toe, bony orbit not closed behind, mostly more than two teats, and a campanulate (diffuse) placenta.

A singular mixed assemblage of tropical animals, which, in defiance of all anatomical grounds, have always been associated by ignorant animal-stuffers with the apes and monkeys, solely on account of the possession of an opposable hallux or pollex on all four extremities. But it is now known to scientific naturalists that the points of distinction from the monkeys are so important that we must rather rank the Prosimii, or at least some of them, among the lowest mammals, a proceeding to which there is the less reason for holding the existence of the opposable digits in question to be an objection, since such digits are frequently met with fully developed on the hind-limbs even of low forms of marsupials.

The brain-case is roundish or longish with crests and ridges very little marked, a condition connected with the weakness of the jaws and their muscles. Even in those genera in which the eye is very large it lies altogether behind the facial region, which with the bony nose mostly appears to be drawn forwards almost in the form of a tube. The bony orbits are never complete as in the Simiæ, but are merely surrounded by an external ring (and even that in Galeopithecus is not complete), their cavities being continuous behind with the temporal fossæ or depressions at the temples. This single decisive character enables us to distinguish at the first glance the skull of one of the Prosimii from one of the Simiæ.

The eyes and the orbits inclosing them are commonly very large, as in most nocturnal animals, and in some, as the loris and tarsier, are so enormous that only a thin plate of bone, as thin as a piece of paper, separates the two orbits, and only a narrow canal is left in the middle line for the passage of the nerves of smell to the nostrils, which are much elongated. In others again, the lemur, the indris, and the aye-aye, the bridge of the nose is broad, and the eyes appear to be placed more to the side as in Carnivora and other mammals. The tear-ducts, which in all the Simiæ as in man, lie in the inner angle of the orbit, are found in the lemurs, as in most marsupials, outside the orbits on the cheeks.

The jaws, as already remarked, are mostly weak. In some (Indris, Lemur) the premaxilla becomes fused very early with the upper jaw, while in others (Tarsius, Loris, Microcebus) the sutures or lines of union remain visible all through life. The lower jaw is always slender, never high, as in many of the Simiæ, and its two halves always remain separated by a suture, which is even in many cases so lax that the two halves fall apart when one attempts to obtain a skeleton of the animal. This character also suffices to distinguish at the first glance the lower jaw of a prosimian from that of a monkey.

While the dentition of the Simiæ presents very constant numbers and relations, it is, on the contrary, remarkably variable among the Prosimii, and that both in respect of the number of teeth and in respect of the structure of the different sorts of teeth. In general one may say that the dental system, especially through the presence of double rows of sharp-pointed cusps on the molars as well as through the variations in the development of the incisors and canines, is intimately allied to that of the insectivores or marsupials, and at any rate is altogether removed from that of the monkeys. For the most part a more or less considerable gap or diastema separates the upper incisors in the same way as in the bats, and the broad crowns of the incisors are sometimes, as in Indris, placed sideways, similarly to what we meet with in the kangaroos. In other cases, as in Tarsius, on the other hand, the hook-like curved middle incisors of the upper jaw stand close together, and far surpass in length the canines as well as the crowns of all the other teeth, while in the aye-aye the middle incisors, which are the only ones that are present in both upper and under jaw, entirely correspond to those of the rodents in structure and in the absence of roots. The incisors of the lower jaw are always pressed close together in the middle, are frequently six in number, and are more or less flattened on the sides; sometimes (Lemur, Indris) they are placed horizontally as in the kangaroos, while in Galeopithecus they are even expanded and split into strips, as in the rat-kangaroo (Hypsiprymnus).—Canines are altogether wanting in the adult aye-aye, being only found (in the upper jaw) in the milk-dentition. In Tarsius they are small and insignificant; in others (Galago, Loris, Microcebus) they are more prominent and stronger, and hook-like with a cutting edge; in the true lemurs and in the genus Indris they are triangular with a cutting edge, and in Galeopithecus the first premolar, as in many Insectivora, plays the part of a canine as regards form and position.—The premolars, which are present in the milk-dentition in the aye-aye, are absent in the permanent dentition, and its few molars are simple stumps with a smooth surface without enamel folds or cusps, as in many rodents. Among most of the others the premolars form a sharp point, but through the development of an inner tubercle as well as through the division of the sharp point gradually pass into the form of permanent molars, which mostly possess four sharp cusps both in the upper and under jaw, these cusps standing opposite one another in pairs and interlocking when the mouth is shut. True diastemas occur in the aye-aye and in those genera (Lemur, Indris) in which the canine in front is developed in breadth; in the other cases the crowns of the teeth meet and merely present indentations opposite the projecting cusps of the teeth of the opposite jaw.

The dentition constitutes beyond doubt the most conservative element of the skeleton. Constant relations in this part of the structure bear witness to a common origin. But, as may be seen from the preceding sketch, no general scheme of the dentition of the Prosimii can be drawn up; a proof that this is only an apparent group of animals heterogeneously composed of the descendants of various stocks, the types represented in which approach one another only in the form of their limbs.

The brain has not the least resemblance to that of the apes and monkeys. While the smooth cerebrum of the small Clawed Monkeys still covers the cerebellum completely, the latter is almost entirely free in the Prosimii, and the few fissures or folds which the cerebrum shows do not agree in their arrangement with the general plan of structure seen in the

Simiæ. The brain resembles that of the Insectivora.

Just as little does the structure of the rest of the skeleton correspond to that of the Simiæ. The cervical, dorsal, and lumbar portions of the vertebral column (that is, the portion in front of the ribs, the portion bearing the ribs, and the portion behind the ribs) are those of a mammal climbing on all-fours; the narrow pelvis connected with a sacrum of only a few vertebræ does not resemble that of the Simiæ.

Although all the prosimians are climbers, yet the structure of the limbs exhibits great diversities. In the aye-aye and the lemurs the upper-arm is as long as the fore-arm, in the others somewhat shorter, in the Galago quite short, and in this last, as in the aye-aye, it is stout and massive, while it is in other cases long and cylindrical. The femur or thigh-bone is always long, often longer than the tibia; in the fore-arm, radius and ulna display great varieties of structure. In many forms, as in Galago and Tarsius, the chief bones of the ankle (the scaphoid and calcaneum) are greatly elongated. The digits and nails or claws exhibit multiform variations. Galeopithecus has sharp claws on all the digits and neither hallux nor pollex opposable. The aye-aye has flat nails only on hallux and pollex, on the other digits claws, and only the hallux is opposable. In all there is a claw at least upon the second digit of the hind-foot, and in Tarsius the toes expand, as in the tree-frogs, into discs, on which there are small rudimentary flat nails.

As there is no likeness to the brain of the Simiæ in the smooth brain of the Prosimii, so also do the other organs of the latter fail to present the slightest resemblance to the corresponding organs of the former. None of the Prosimii has a human-like ear, this organ being sometimes small, but covered with hair and pointed, sometimes naked, but in that case very large and capable of being rolled up as in the Chiroptera (Bats). The uterus is bicornuate (two-horned), sometimes even quite divided. Besides the pectoral teats, found in all animals which carry their young clinging to their breast, there are mostly others also, situated on the abdomen or even in the region of the groin. Usually the whole body, with the exception of the point of the nose, is covered with hair; the fur is mostly thick and woolly. As in the sloths, the vessels of the thigh and the upper-arm, the arteries and veins in the region of the groin and axilla break up into plexuses of small vessels, so called *retia mirabilia*, which afterwards unite again into common trunks.

It would lead us too far if I were now to go into a number of other details of anatomical structure, which all serve to show, on the one hand, the fundamental difference of the Prosimii from the Simiæ, and, on the other hand, the distinctions prevailing between the different families of the Prosimii. Further investigations will without doubt afford us the means of breaking up this manifestly unnatural order into its separate constituents.

But I may draw attention to one other essential point. Great weight has justly been attached to the form of the placenta, although it is going too far to regard it, as some do, as the most important character for the classification of mammals. The Simiæ have, like man, a discoidal placenta, which is sometimes entire, sometimes divided; but the Prosimii which have thus far been examined (Propithecus, Lepidilemur, Hapalemur, Chirogaleus) possess a placenta composed of separate villi, which covers the whole egg except the apical pole, and the form of which, campanulate, as it is called, allies it on the one side to the zonary or belt-shaped placenta of the Carnivora and on the other to the diffuse placenta of the Ungulata. This latter relation especially has great significance, as the fossil remains of Prosimii prove. Unfortunately these investigations extend so far only to the family of the lemurs, and we must await future researches in order to learn whether this character, which entirely separates the Prosimii from the Simiæ, holds good also with reference to the other families, which might well be doubted.

All the Prosimii are tropical nocturnal climbers, in which the general habits of nocturnal animals are represented in different degrees. While the true lemurs are to be seen not infrequently even by day, the aye-aye, the tarsier, the galagos, and the loris move about only by night and sleep during the day, rolled up in dark retreats. Many are sleepy and sluggish in their movements; but the power of leaping is exhibited in different degrees of development in different forms. This power is seen at its highest in Tarsius and Galeopithecus, in the latter of which it is assisted by an expansion of the skin which stretches between the body and the limbs, and acts as a parachute. The structure of the limbs in different forms harmonizes with these various powers of movement. While the true lemurs, which prowl about with a cat-like stealthiness, have all the limbs of equal length, we see a gradual shortening of the fore-limbs and lengthening of the hind-limbs in the aye-aye, galagos, and tarsier, and in the two latter the power of leaping is increased by the fact that the ankle-bones attain an extraordinary length, so that the structure of the foot approaches in some measure that of birds. On the other hand, one might be disposed to say that in Indris and Loris the arrangement seen in Galeopithecus is in a certain sense anticipated by the equal lengthening of both pairs of limbs.

Most of the Prosimii bring forth only one young one at a birth, and this they carry about with them for a considerable time after. Still we are at liberty to presume that in some species, in which the females have several pairs of teats, several young ones are born at once and are tended in holes of trees.

We subdivide these animals according to their geographical distribution, since a systematic classification appears impracticable.

THE PROSIMIANS OF MADAGASCAR.

The Lemurs (*Lemurida*).

The lemurs (*Lemurida*) are animals which may attain the size of cats, and which, while bearing most resemblance in the general form of body to the Mammalia of other orders, are distinguished by their dentition. In the upper jaw there are always two very small incisors placed vertically and scarcely separated by an interval in the middle line, and these are followed by a large canine often curved hook-wise or triangular in form. There next follows a gap or diastema for the reception of the canine of the lower jaw. After that come three single-cusped premolars, which, however, through the gradual development of an internal process, approach the form of the three molars. These last have two exterior cusps and a rounded internal heel or process, so that they resemble the so-called carnassial teeth of many carnivores.—In the lower jaw three very narrow but long incisors are inserted horizontally very close to one another on each side. Then follows the small canine, after which come two single-cusped premolars, and then three molars, on each of which there are four more or less well-marked but not very sharp tubercles, separated by a transverse furrow. The dental formula is $\frac{2 \cdot 1 \cdot 3 \cdot 3}{3 \cdot 1 \cdot 2 \cdot 3}$ = 36 teeth. The last molar is generally the smallest in both jaws.

The family we are now dealing with is one rich in genera and species, and one in which we may recognize, first, in the dentition a greater or less tendency to the use of animal food, and, secondly, in the structure of the ankle an aptitude for leaping.

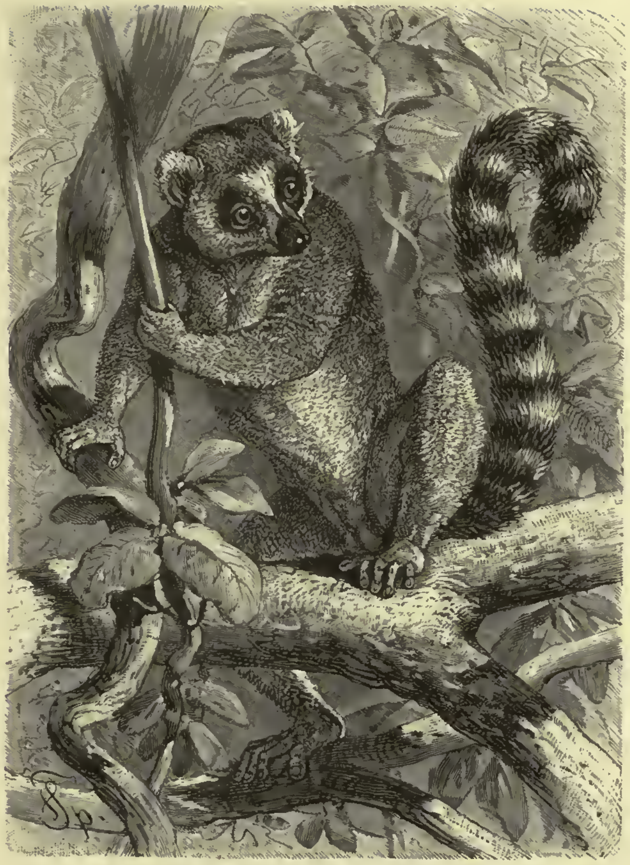


Fig. 25.—Ring-tailed Lemur (*Lemur catta*). page 83.

Thus the so-called **Dwarf Lemur** (*Microcebus myoxinus*) shows such an elongation of the scaphoid and calcaneum as to remind us of the Galagos of Africa, and to serve as the type of a sub-family known as the Macrotarsi. In the **Weasel Lemurs** (Lepidilemur) the upper incisors are shed very early without leaving any traces, and the short canines and blunt-tubercled molars indicate, as in the Hapalemurs, a more purely vegetable diet, which, indeed, seems to be proved in the case of the latter genus at least, since only bamboo leaves have been found in the stomach. The greatly enlarged cæcal expansion of the stomach and the long cæcum in all lemurs point to the same kind of nourishment. Slight variations in the structure of the hands and feet, in the number of the teats, and so on, have served as means for distinguishing the genera.

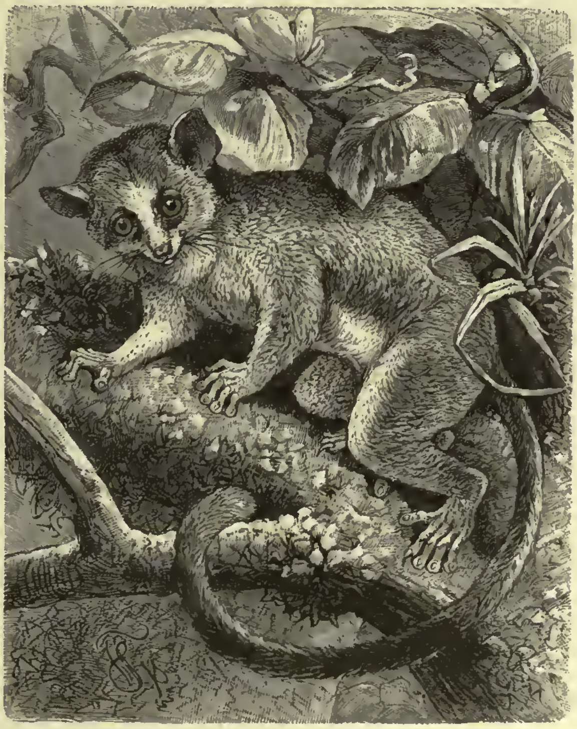


Fig. 26.—The Dwarf Lemur (*Microcebus myoxinus*). page 83.

All the lemurs have a rounded skull with more or less projecting muzzle, so that the names of **Fox (Ring-tailed)**[1] **Lemur** (*Lemur catta*) and **Cat (Mouse) Lemur** (*Chirogaleus*) have been applied to certain forms on account of a general resemblance in external form to the animals named. The ears are of medium size and abundantly covered with hair, never naked. The eyes are rather small than large for nocturnal animals. The nostrils are at the end of the muzzle. The whole face, as well as the backs of the hands and feet, are thinly covered with hair, but elsewhere the fur is thick, fine, woolly, and mostly short. The two pairs of limbs, except in the Macrotarsi, are almost equal in length; the pollex (thumb) is less developed than the hallux (great toe). All the digits, except the claw-bearing second digit of the hind-feet, are covered with flat or sometimes slightly arched nails. The tail is mostly longer than the body, and bushy, like that of a squirrel.

The colour of the

---

[1] The first name is a translation of that used in German, the one in parentheses the name used by English writers.—Tr.

fur is generally grayish-brown, ash-gray, or grayish-yellow, and lighter on the under side than on the back. Usually the colour is adapted to that of the branches of the trees which they frequent. Still brighter colours, rusty-red for example, and constant markings in the form of stripes, spots, and light and dark rings on the tail also occur. Some species vary very much in colour, and in others the males and females are so different that they have been mistaken for different species.

All the lemurs live socially and lead a nocturnal life, sleeping through the day, curled up with their tails over them, either singly or sometimes in pairs; and the smaller species inhabit either holes in trees (Chirogaleus), or artificial nests like those of the dwarf lemur (Microcebus). The females in the latter genus have, besides the usual pectoral teats, a pair of teats in the abdominal region, which leads us to infer that they bring up a numerous offspring in their nests. The sleep of the lemurs is not so sound that they are not liable to be awakened even by slight noises. The hind-feet of the true lemurs possess a remarkable arrangement of muscles and sinews at the ankle-joint, by means of which, when the limb is bent, the foot completely embraces the branch on which the animal sits. The creature is thus enabled to sit firmly while sleeping without any muscular exertion. The apparatus continues to act even for some days after death. A black lemur which I was dissecting, firmly embraced my thumb in this way when I bent its leg.

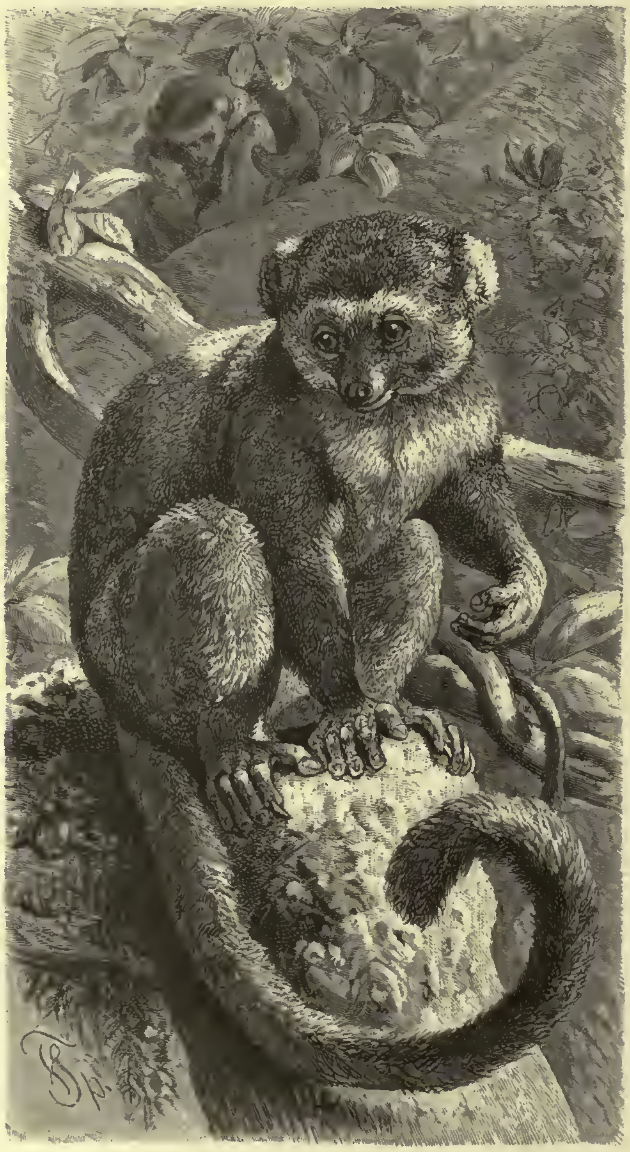


Fig. 27.—The Gray or Broad-nosed Lemur (*Hapalemur griseus*).

After sunset the lemurs awake, arrange their fur, and then, amid loud cries, go in search of their food. Some species have a very loud voice, and since they often practise their music in companies of thirty or forty, and appear mutually to try to outvie one another, like the American howling monkeys, their choruses are truly excruciating to the ear. The voice of the ruffed lemur (*Lemur varius*), a creature only 16 inches in length, is said to be so like the growl of a lion as to inspire terror. After such concerts the whole band betakes itself to search for food, performing, meanwhile, the most audacious feats in climbing, leaping, and other kinds of gymnastics. During their foray they work incredible devastation among the fruit-trees; devastations, however, which are of no serious consequence to man since they are wrought only in the inmost depths of the primeval forests. The young come into the world already covered with hair, and coloured like their parents. At first they cling fast between the legs of the mother, who tends them with loving care. Wounded lemurs defend themselves vigorously with their teeth and claws against men and dogs. Their flesh is esteemed.

In captivity they seem to be rather stupid, but they accustom themselves easily to society, live on peaceable terms with other animals, take kindly to a mixed, largely vegetable diet, are fond of being stroked, and gently scratched with the finger-tips, but otherwise excite little interest, since it is only at night that they become really lively. Some species are now to be found in all zoological gardens.

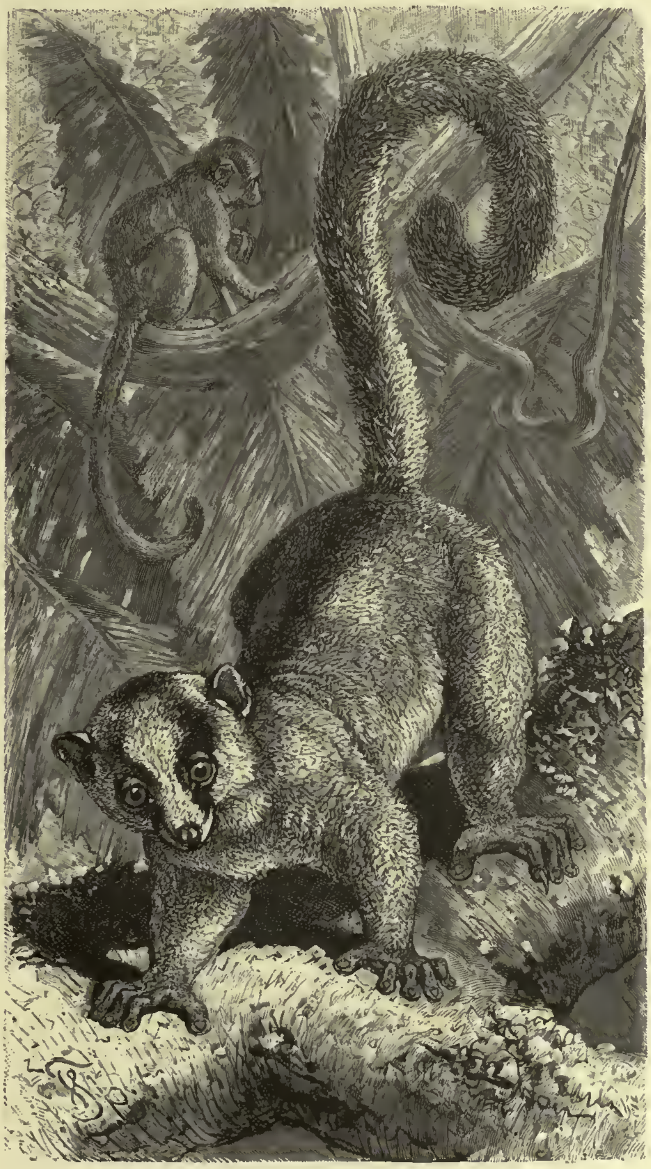


Fig. 28.—The Waluvi or Forked-crowned Mouse Lemur (*Chirogaleus furcifer*). page 84.

The **Ring-tailed Lemur** (*Lemur catta*), fig. 25, is a small elegant animal, with a body of about 16 inches, and a tail of about 20 inches in length. The fine thick woolly fur varies from gray to brown-red. Face, ears, and throat are white, the nose is black, and the eyes are surrounded by black rings, having the appearance of spectacles; the bushy tail is marked with bright coloured rings. This species lives in the south-west of Madagascar, and is said to be distinguished by the elegance of its movements.

The **Dwarf Lemur** (*Microcebus myoxinus*), fig. 26, somewhat resembles our dormouse, which it about equals in size. The chief points of resemblance consist in the long tail becoming bushy towards the end, and the long hairs of the moustache. The large spoon-shaped ears can be folded up. The ankles, as already mentioned, are elongated, the toes furnished with small discs to serve as means of attachment. Besides the pectoral teats the female has two others situated on the abdomen. They build nests for themselves like squirrels, and live only in the densest woods. The species represented in fig. 26 is of a rusty yellow colour with a white streak on the nose.

The **Gray or Broad-nosed Lemur** (*Hapalemur griseus*) or Bokombol of the natives, fig. 27, is an entirely nocturnal animal, which, during the day, however, has only a very light sleep. It grunts like a little pig, climbs and jumps nimbly about in the bamboo thickets by night, living on the bamboo leaves. It has short hairy ears almost hidden in the thick fur of the body, which is of a gray colour, passing into dark brown on the back. The tail is very long, and the dentition is marked by prominent upper incisors.

As in the preceding genera we know also

several species of **Mouse Lemurs**, the best known of which is the **Waluvi** of the natives (*Chirogaleus furcifer*), fig. 28. Its characters are a slender body, tail longer than the body, muzzle and ears pointed, hind-legs longer than the fore-legs, fur woolly, white. It has two black stripes running back from the eyes to the nape of the neck, where they meet, and whence they are continued backwards in a single stripe. The members of this species prefer to live in hollow trees inhabited by bees; they are excellent leapers, and have a sharp trumpet-like voice, which they delight in using by night. The genus is represented in the Zoological Gardens, London.

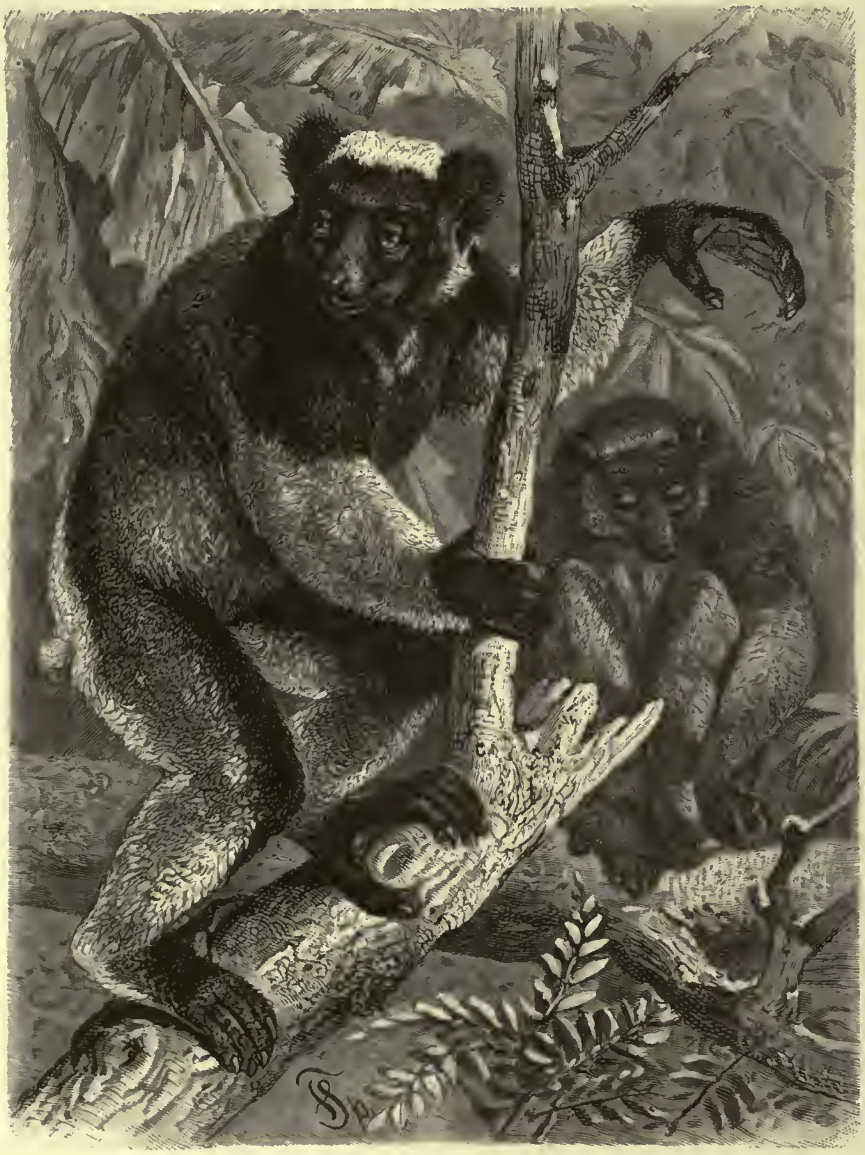


Fig. 29.—The Indris or Babakoto (*Lichanotus Indris*).

The Indris Family (*Indrisida*).

Among the Indrisida are to be found the giants of the Prosimii. The **Indris** (*Lichanotus Indris*), after which the family is named, reaches a height of about three feet when standing upright.

The dentition deviates from that of the lemurs not only in the form of the teeth, but also in the fact that in the under-jaw there are only two horizontal incisors on each side. In the molars of both jaws four tubercles separated by a transverse furrow can be plainly distinguished. The tubercles are moreover blunt, and soon get rubbed away by use, which indicates a decided preference for vegetable food. The dental formula is $\frac{2 \cdot 1 \cdot 2 \cdot 2}{2 \cdot 1 \cdot 2 \cdot 3} = 30$ teeth.

The head is small, the muzzle pointed, the ears thickly covered with hair, and almost hid in the fur, the eyes small for a nocturnal animal, the neck short, the body and limbs slender, the fore-limbs far shorter than the hind ones, the thighs of which are very powerful. The hands and feet are peculiarly striking. Both pollex and hallux (thumb and great toe) stand far apart from the other digits, to which they can be opposed, and the former is specially powerful. All the digits, except these two, are united to one another by a tight skin, and cannot be separated. In this way a true climbing foot, almost like that of the chameleon, is formed, and since hands

UNIVERSITY OF CALIFORNIA

and feet are black on the hairy upper surface in all species, this creature looks as if it had boxing-gloves on all its extremities. These creatures have been divided according to the length of the tail, apart from minor differences, into two genera, each containing several species. One of these comprises the true **Indris** (*Lichanotus*) with short brush-like tail, and to this genus the form shown in fig. 29 belongs. The other consists of the Veiled Lemurs (Propithecus), with tail almost as long as the body. The fur is very thick, soft, almost woolly. Its colours are mixed white and black, inclining in places to dark brown and reddish white. With respect to the distribution of the various patches of colour, there appear to be many individual and sexual variations.

Sleeping lightly by day these creatures jump about in the trees by night like lively monkeys, seeking for their food, which consists of fruits, insects, and small birds. They seem to be the most highly endowed of all the Prosimii, and the accounts of Sonnerat agree with the more recent ones of Pollen in describing them as gentle, good-natured, and easily tamed. Both authorities agree likewise in stating that the typical species, the **Indris** or Babakoto (*Lichanotus Indris*), fig. 29, is trained in parts of Madagascar to hunt for birds, which they surprise and seize with great skill. They eat sitting and holding their plunder in their hands. Their voice is said by some to resemble the crying of a child, by others to be almost deafening when they are present in large numbers. In some parts of the island the Malagasies believe that their ancestors after death are changed into animals of this kind, on which account worship is paid to them, and the leaves of trees on which they have been seen climbing are regarded as remedies for dangerous diseases. So far no one has had an opportunity of observing living Indris in Europe, possibly because the superstitious ideas cherished about them by the natives are an obstacle to their exportation. The name Indris is a native name signifying "man of the woods."

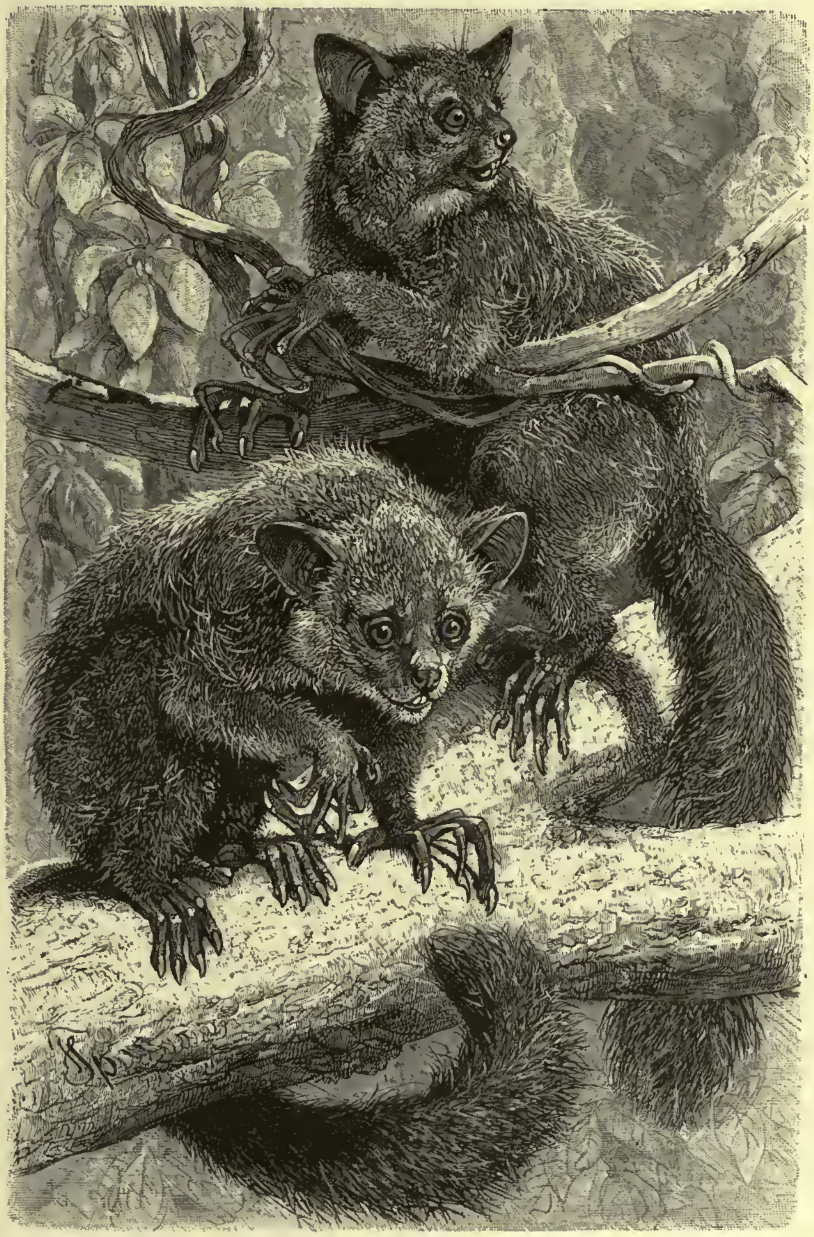


Fig. 30.—The Aye-aye (*Chiromys madagascariensis*). page 86.

The Aye-aye.

The **Aye-aye** (*Chiromys madagascariensis*), fig. 30, one of the rarest animals of the large African island, is a species so peculiar as to form by itself an entire family. On a first hasty glance its large bushy tail and the whole form of its body cause it to resemble a squirrel of about the size of a cat. The head is roundish, the snout but little protruding, the ears large and naked, the eyes large with round and very contracted pupil, the nose naked with sickle-shaped nostrils, the lips provided with long moustache hairs, the fur, which is mostly of a grayish-brown colour, mingled with long bristly hairs, which are specially well developed on the tail.

The adult animal has in each half of the jaw, above and below, a strong sharp chisel-shaped incisor, which is covered in front with a very thick, behind with a very thin layer of enamel, and being without a root reaches back in the jaw to beyond the molars, and keeps constantly growing as it is worn away by use, a tooth accordingly which in all these respects resembles that of the rodents. By their action on one another these incisors get so ground down that their front part projects like a chisel while a broad heel or process is formed behind. After these incisors there follows, as in the rodents, a large gap or diastema, and then in the upper jaw a small premolar, lying very close to the three molars, while in the lower jaw this premolar is wanting. All the molars are simple, round, smooth-polished stumps. The dental formula is thus $\frac{1 \cdot 0 \cdot 1 \cdot 3}{1 \cdot 0 \cdot 0 \cdot 3} = 18$ teeth, and the dentition of the adult is decidedly rodent in character.

Altogether different is the milk-dentition, which has been made known by Peters from the examination of a new-born specimen, as also of one a little older in which the permanent teeth were just on the point of cutting the gum. From this examination it was found that in each jaw, both above and below, there exists a second incisor, which afterwards drops out, that in the upper jaw there is a canine which is also ultimately lost, that both above and below these appear two premolars, which on the change of teeth disappear entirely below, while the hinder of the two is replaced in the upper jaw by a permanent tooth. The milk-dentition accordingly comprises exactly the same number of teeth as the permanent, since in place of the three permanent molars of the upper jaw there are one incisor, one canine, and one premolar, and in place of those of the lower jaw one incisor and two premolars. The incisors of the milk-dentition are divided into lobes and notched.

That an animal with a dentition of this nature cannot be regarded as belonging to the rodents or gnawing animals, but must be ranked with the prosimians, is beyond question. But through the alteration of the dental system above described the aye-aye becomes one of the most remarkable animals in creation. The inherited prosimian dentition, indicated in the dental formula of the milk-teeth, has, by adaptation to an altered mode of life, become converted into that of a rodent through the disappearance of characteristic elements.

The hands and feet are formed in a highly peculiar manner Only the great toes have a flat nail, all the other toes and all the fingers having claw-like arched nails. The great toe is opposable and very powerful, but the thumb, on the other hand, is small, and has the same direction as the other fingers. The fourth finger is inordinately long, the fourth digit of the feet not so much so; the middle finger is extraordinarily thin, the first joint (phalanx) very long and curved, the small phalanx carrying the claw very short, so that the finger rather looks like a jointed awl than a true finger.

The aye-aye is the most persistent day-sleeper known. Even a good shaking cannot rouse the creature from its profound slumbers. Only one specimen has hitherto been brought alive to Europe, a specimen kept in the Zoological Gardens of London; and once when, on hearing it rustling in its straw, I wished to examine it by lamp-light the creature instantly rolled itself up into a ball, putting its head between its legs and wrapping its tail round both. In its native land the animal sleeps by day in bamboo thickets. By night, however, it is lively, climbing up and down on the trees, and leaping actively and cleverly. It utters a sort of grunting sound, and seeks its food, which consists of insects, larvæ, and the sweet pith of the sugar and bamboo canes, by gnawing a hole in the cane or in trees and then transfixing its prey with its thin withered-up middle finger, or scooping out the pith by means of the same. The London specimen was very lazy, ill-natured, and apt to bite, but this was unquestionably due to its long captivity, for Sonnerat, who discovered the creature in Madagascar, describes it as good-natured and confiding.

THE AFRICAN PROSIMIANS.

The Potto Family (*Pterodictida*).

The family of the Pottos or the African Slow Lemurs is composed of only two nocturnal animals, with woolly fur, medium-sized round eyes, and short naked ears, somewhat pointed snout, slender body, short tail, fore- and hind-limbs of almost equal length, but with rather large hands, which have only a rudimentary nailless forefinger. They have in each jaw above and below only two incisors, the lower ones placed horizontally, sharp-edged canines, three single-cusped premolars, and the same number of tolerably sharp-cusped molars. The dental formula is $\frac{2 \cdot 1 \cdot 3 \cdot 3}{2 \cdot 1 \cdot 3 \cdot 3} = 36$ teeth.

Two genera, Pterodicticus and Arctocebus, have been formed rather unnecessarily out of the two species, the **Potto** and **Angwantibo**, living respectively in Sierra Leone and Old Calabar, the points of distinction being the degree of development of the forefinger and tail. In accordance with this division these two species are called in scientific nomenclature *Pterodicticus Potto* (fig. 31) and *Arctocebus calabarensis* (fig. 32). Both species have large thumbs and great toes covered with a flat nail, flat nails on all the digits except the second of the hind-feet, which has a large erect sharp claw. In the potto the fore-finger, though rudimentary, is still recognizable, the tail stump-like, the body slender; while in the plump angwantibo, which has larger eyes and ears than the potto, the forefinger has shrunk to a mere wart, and the tail likewise is so reduced in size as to be quite hidden in the fur, which is much more woolly than that of the potto. On account of the large eyes and ears this form is sometimes called the bear-lemur.

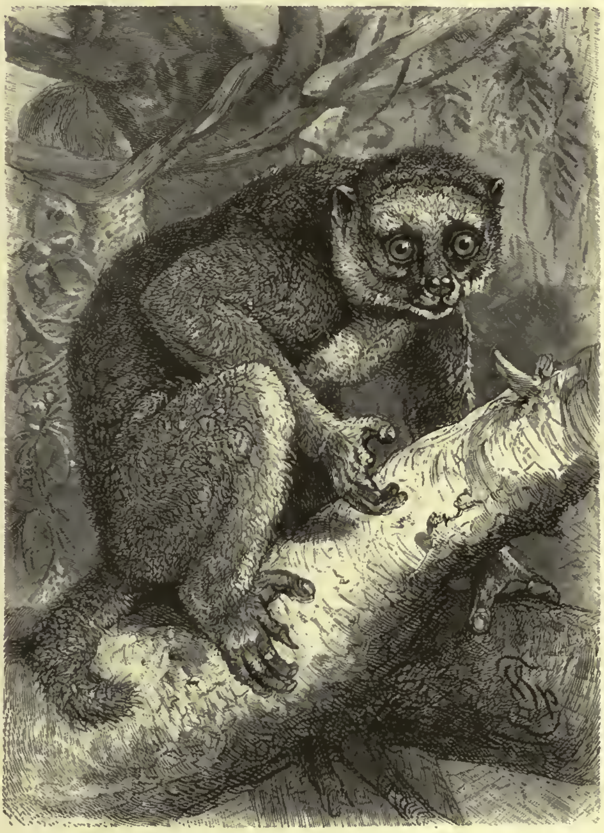


Fig. 31.—The Potto (*Pterodicticus Potto*).

So far as our scanty information regarding these creatures reaches, they sleep by day rolled up in dark hiding-places, but by night become very active and lively, climbing and jumping about in search of their food, which consists chiefly of all sorts of fruits, but partly also of insects, eggs, and small birds. The pottos living in the Zoological Gardens in London caught birds introduced into their cage very dexterously, tore them instantly into pieces, and appeared to be very well satisfied with this sort of food.

The Galagos (*Galagonida*).

The members of this family are large-eared, long-tailed, African forms, constituting only a single genus (Otolicnus or Galago), but one which comprises a pretty large number of species. The largest species (*Otolicnus* (*Galago*) *crassicaudatus*), the **Grand or Thick-tailed Galago,** attains a length of about 12 inches exclusive of the tail, which measures 15 or 16 inches; most of the other species are at most 8 inches long. They inhabit the forests of tropical Africa from Zanzibar to the Guinea Coast.

A thick soft woolly fur covers the whole body. The tail is covered with thicker and stiffer hairs. The ears, nose, hands, and feet are naked.

On the round almost catlike head, in which there are large eyes with oval pupils contracting by day to narrow vertical slits, we are at once struck by the large naked ears with rims or borders on the inner edge. By night these ears are expanded in the form of paper-cornets, but by day and in a state of rest are rolled up so as entirely to stop the sense of hearing. The body is small and weak, the hind-legs much longer and stronger than the fore-legs. The two chief bones of the ankle, the calcaneum and the scaphoid, are so elongated as to measure half the length of the lower leg; the digits are long and powerful, and all except the second digit of the hind-foot, which carries a claw, provided with flat nails. The second digit of the fore-foot (the index, or so to speak, fore-finger) is shortened, but carries a small nail. Although the female is said to bring forth only one young one at a birth, it has three pairs of teats. The young one is carried about by the mother clinging to her body.

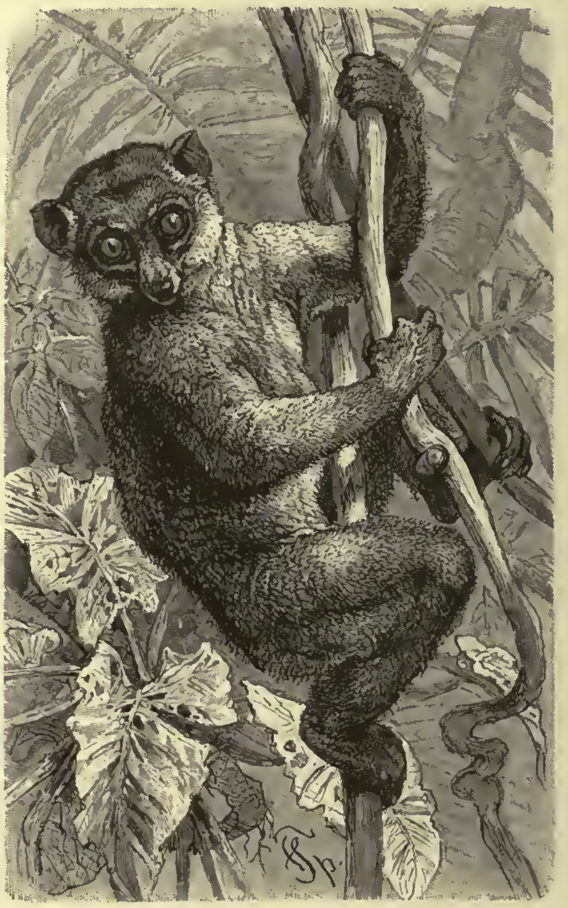


Fig. 32.—The Angwantibo (*Arctocebus calabarensis*). page 87.

The dentition indicates rather an animal than a vegetable diet. In the upper jaw there are on each side two chisel-shaped vertical incisors separated by a gap, while in the lower jaw there are three incisors on each side placed horizontally. The canines are sharp, furrowed, and curved; the adjacent premolars, both above and below, almost of the same form and size as the canines. Next follow in the upper jaw one, in the lower jaw two single-cusped premolars, and then in the upper four, in the lower three molars with three or four pretty sharp cusps, and besides these, in the largest species, sometimes a small fifth molar in the upper jaw. The dental formula is $\frac{2 \cdot 1 \cdot 2 \cdot 4}{3 \cdot 1 \cdot 2 \cdot 3} = 36$.

These little creatures live in pairs, are most frequently to be met with in the mimosa or gum-acacia forests, sleep by day with the head squeezed in between the front legs and the long tail wrapped round, but by night are extremely lively and agile while they go hunting after their food, which consists essentially of insects, small birds, and mice, to which sweet fruits and juices are sometimes added as a seasoning. The accounts of observers are not quite in harmony with one another; perhaps in consequence of the fact that the habits of separate species inhabiting different districts are not quite the same. While the galagos living in West Africa are described as persistent day-sleepers and harmless fruit and gum eaters, it is reported of their Eastern kindred, on the contrary, that though they do not take to flight in the presence of man, they are roused from their slumbers even by the sound of approaching footsteps, that they climb and jump about among the trees with great agility and vivacity, and that by night they go ravaging like true beasts of prey among insects and other animals of small size. In Zanzibar the **Komba** (*Otolicnus agisymbanus*) is said frequently to make itself intoxicated with palm wine, so that it falls from the tree and gets caught. The little creatures are easily tamed, become confiding and affectionate, and delight their owners by their lively movements and the exhibition of their powers of climbing and leaping, while moreover they repay the attention bestowed upon them by the assiduity with which by night they hunt after all sorts of noxious vermin, which are so abundant in the tropics, especially after cockroaches and mice. The species represented in fig. 33, the **Galago** proper (*Otolicnus Galago*), appears to range over the whole of tropical Africa, It has a woolly fur, of a sort of gray fawn-colour on the back, whitish beneath, and flesh-coloured ears.

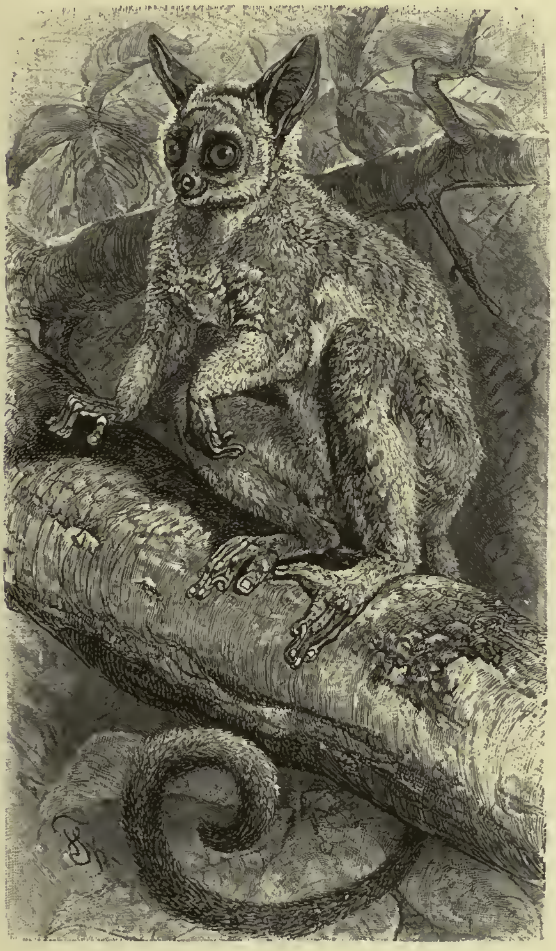


Fig. 33.—The Common Galago (*Otolicnus Galago*).

THE EAST INDIAN PROSIMIANS.

The Loris (*Lorisida*).

The members of this family are forms with pointed snouts, large eyes, slender bodies, long thin limbs, short fore-finger, and rudimentary tail, or no tail at all.

They correspond to the African pottos, and form only a single genus (Stenops or Loris), although the plumper species have been separated by some under the name of Nycticebus. They are small animals, for the **Plump Loris** (*Stenops* or *Nycticebus tardigradus*), the largest species, attains only a length of 14 inches. In their habits they are altogether nocturnal, and they live wholly on animal food, especially insects and birds. The dentition shows the same number of teeth as that of the galagos, but is distinguished from the latter by the fact that, in the upper jaw the outer incisor is much smaller than the inner, and that there is one premolar more and one molar less. Dental formula $\frac{2 \cdot 1 \cdot 3 \cdot 3}{3 \cdot 1 \cdot 2 \cdot 3}$ = 36 teeth.

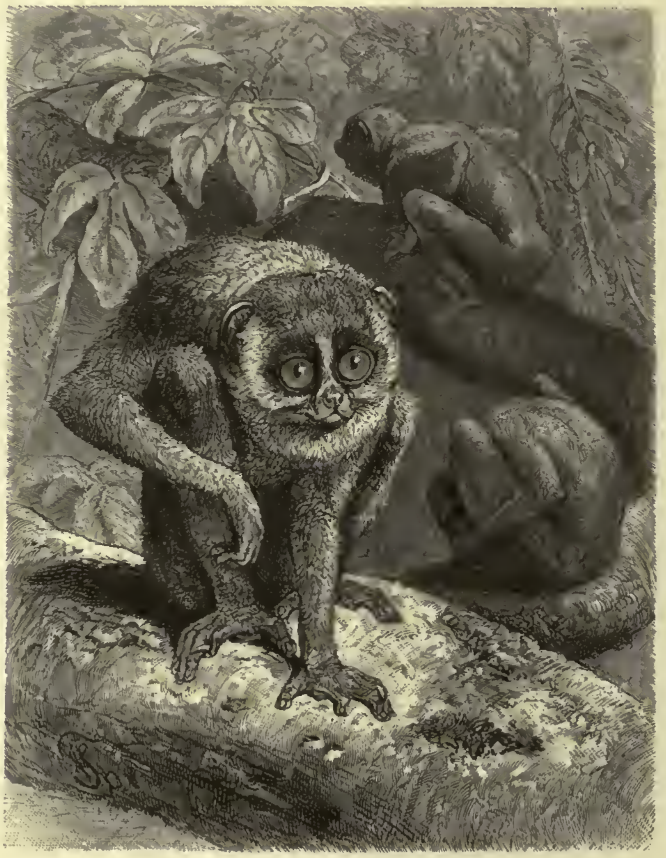


Fig. 34.—The Slow-paced Lemur or Slender Loris (*Stenops gracilis*).

The **Slow-paced Lemur** or Slender Loris (*Stenops gracilis*), fig. 34, which inhabits Malabar, Madras, and Ceylon, has a body of at most 10 inches in length, a round head scarcely separated from the body by the thick neck, rounded slightly hairy ears, and large round owl-like eyes, so near one another that the nose, which is pointed in such a manner as to give the creature a rather impudent look, forms only a narrow partition between them. The body is small and weak, the abdomen contracted, the limbs long and thin, the hind ones much longer than the fore ones, the hands and feet long and narrow, the thumbs and great toes short, but powerful and far apart, the second digit of the hand (the fore-finger) short, that of the foot armed with a claw.

The little animals sleep by day in a very singular position, rolled up into a ball, with their head between the hind-legs, often hanging like sloths to a branch of a tree. After sunset they wake up, set themselves to rights, and proceed slowly and deliberately with inaudible steps after their plunder. They climb cleverly, but with great caution, always testing with the hand or foot before they take hold or pass from one branch to another. The fingers and toes, which are provided with flat nails, have rather broad cushions below, which appear to cling to foreign surfaces. It appears to be quite indifferent to the loris whether they move about on the branches or suspended from them. Their eyes gleam brightly in the dark. When a loris catches sight of its prey, it first looks long and steadfastly at it, then crawls slowly up, and finally, with a sudden leap, seizes it with its hand, and if it is a bird, bites through its head in order to regale itself on the brain, which forms its favourite food. Like all nocturnal animals, these also are accused by the natives of all sorts of misdeeds, and are tortured to death in every imaginable way. The plump loris, abundant both in the island of Sumatra and on the mainland, is, indeed, much larger and more powerfully built than the previous species, but appears to be even plumper than it is on account of its thicker fur. In captivity they appear to be stupid, lazy, tedious creatures.

The following interesting account of a slow-paced lemur kept by Sir William Jones, the Orientalist, in India, is contained in the fourth volume of the *Asiatic Researches*:—

"In his manners he was, for the most part, gentle, except in the cold season, when his temper seemed wholly changed; and his Creator, who made him so sensible of cold, to which he must often have been exposed even in his native forests, gave him, probably for that reason, his thick fur, which we rarely see on animals in these tropical climates. To me, who not only constantly fed him, but bathed him twice a week in water accommodated to the seasons, and whom he clearly distinguished from others, he was at all times grateful, but, when I disturbed him in winter, he was usually indignant, and seemed to reproach me with the uneasiness which he felt, though no possible precautions had been omitted to keep him in a proper degree of warmth. At all times he was pleased with being stroked on the head and throat, and frequently suffered me to touch his extremely sharp teeth; but at all times his temper was quick, and, when he was unseasonably disturbed, he expressed a little resentment by an obscure murmur, like that of a squirrel, or a greater degree of displeasure by a peevish cry, especially in winter, when he was often as fierce, on being much importuned, as any beast of the woods. From half an hour after sunrise to half an hour before sunset he slept without intermission, rolled up like a hedgehog; and, as soon as he awoke, he began to prepare himself for the labours of *his* approaching day, licking and dressing himself like a cat, an operation which the flexibility of his neck and limbs enabled him to perform very completely; he was then ready for a slight breakfast, after which he commonly took a short nap, but, when the sun was quite set, he recovered all his vivacity. His ordinary food was the sweet fruit of this country, plantains always, and mangos during the season, but he refused peaches, and was not fond of mulberries, or even of guaiavas; milk he lapped eagerly, but was contented with plain water. In general he was not voracious, but never satiated with grasshoppers, and passed the whole night, while the hot season lasted, in prowling for them. When a grasshopper or any insect alighted within his reach, his eyes, which he fixed on his prey, glowed with uncommon fire; and, having drawn himself back to spring on it with greater force, he seized the victim with both his fore-paws, but held it in one of them while he devoured it. For other purposes, and sometimes even for that of holding his food, he used all his paws indifferently as hands, and frequently grasped with one of them the higher part of his ample cage, while his three others were severally engaged at the bottom of it; and in the evening he usually stood erect for many minutes, playing on the wires with his fingers, and rapidly moving his body from side to side, as if he had found the utility of exercise in his unnatural state of confinement. A little before daybreak, when my early hours gave me frequent opportunities of observing him, he seemed to solicit my attention, and if I presented my finger to him he licked or nibbled it with great gentleness, but eagerly took fruit when I offered it, though he seldom ate much at his morning repast. When the *day brought back his night*, his eyes lost their lustre and strength, and he composed himself for a slumber of ten or eleven hours. . . .

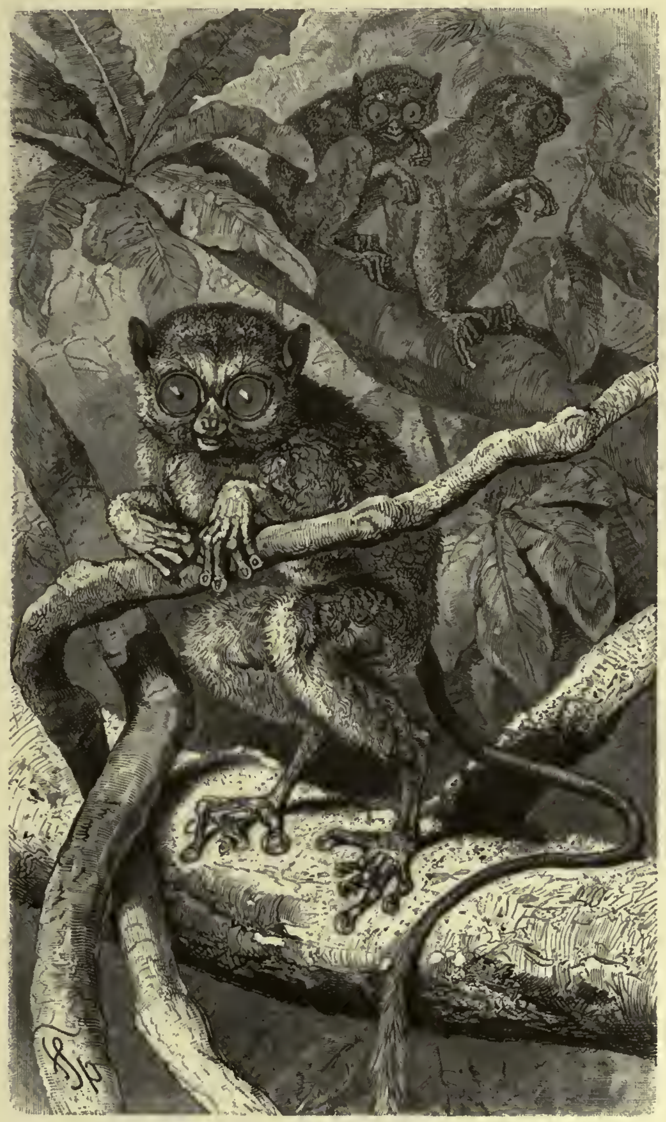


Fig. 35.—The Spectre-larsier (*Tarsius spectrum*). page 92.

My little friend was, on the whole, very engaging; and, when he was found lifeless in the same posture in which he would naturally have slept, I consoled myself with believing that he had died without pain, and lived with as much pleasure as he could have enjoyed in a state of captivity."

The Spectre-tarsier.

This creature, known to naturalists as *Tarsius spectrum* (fig. 35), ranges from Sumatra, Java, and Borneo to Celebes and the Philippines, and is the sole species of a very peculiar genus. It is a small animal (body about 6, tail about 10 inches long), resembling the jumping mouse or jerboa in general form, with large round eyes, short fore-feet, long jumping legs, and very long tufted tail.

This little creature might be considered as a one-sided development of the type of the loris. The head and especially the skull have in fact much resemblance to those of the latter; only the circular, yellow, or light brown eyes, gleaming by night as they do, are so enormous, that according to the expression of one observer, the head, sitting upon the short thick neck, appears like a blind lantern, capable of being turned by a ball-and-socket joint in all directions. The body is round, compact, covered to the wrist and ankle with fine thick woolly fur of a brownish-gray colour, but lighter on the under side. The muzzle is broad, the small nose not prominent, the ears of moderate size, but yet provided with internal raised borders. The fore-limbs are very short, the hands long, the thumb slightly developed and not opposable, the middle finger the longest, all furnished with flat nails, which are a little arched in the middle. The length of the legs is mainly due to the almost naked, cylindrical, fleshless, tarsal region of the foot, which is formed out of the elongated ankle-bones known as the scaphoid and calcaneum. The foot has very long spread-out toes. The great toe is large and powerful, and it, as well as the fourth and fifth toes, carry flat nails, while the second and third toes have short erect claws. All the digits both of the fore and hind feet have on the under side callous round cushions, by means of which the creature appears to adhere firmly to foreign surfaces like the tree-frog. The tail, as in the jerboas, is excessively long, cylindrical in shape, and adorned at the end with a kind of tuft. It serves as a support in sitting and as a rudder in leaping.

The dentition is a purely insectivorous one. In the upper jaw incisors, canines, and premolars have the same sharp somewhat hook-like form. The innermost incisor is the most prominent, the second is smaller, the canine again larger, the first premolar very small, the second larger, the third two-cusped, the molars broader than long with sharp cusps on the outer edge. In the lower jaw the canine is the largest tooth, and the incisors are small but vertically placed. Dental formula $\frac{2 \cdot 1 \cdot 3 \cdot 3}{1 \cdot 1 \cdot 3 \cdot 3} = 34$ teeth.

Nocturnal in their habits, though even by day they never sleep very soundly, these little creatures, which live in pairs in the densest parts of bamboo thickets, are regarded by the natives with dread and abhorrence. They have every kind of evil attributed to them. By day they are sulky and ill-humoured and sleep a great deal, but by night they are lively and amuse themselves with jumping, going noiselessly after their prey, which consists solely of insects, crabs, and small lizards. They catch their booty with the hands while jumping, and appear to be very voracious. Only one young one is brought forth at a birth, and it comes into the world already covered with hair; even on the second day it begins to climb, but as a rule it clings to the legs of its mother, which for a long time carries it about with it, often holding it in its mouth as cats do. In captivity the creature becomes confiding and affectionate, but no one has yet succeeded in bringing a living specimen to Europe.

LIBRARY
OF TH
UNIVERSITY
OF
CALIFORNIA

The Colugos (*Galeopithecidæ*).

The Colugos, flying-lemurs or flying-cats, forming the genus Galeopithecus,[1] and the family of the Galeopithecidæ are animals which have somewhat of the appearance of gigantic bats. The best-known form has a body of about 12 inches in length, and a tail of about 8 inches in length. Attached to the sides of the body and the tail is a hair-clad fold of skin, called the patagium, which, when expanded, measures about 16 inches across before and behind. The head is long and pointed, the ears are pretty large, almost naked, somewhat rounded, the eyes prominent, the nostrils at the point of the snout but placed sidewards, and separated by a broad partition. The neck is short, the body slender, the tail thin and long. The patagium runs from the sides of the neck to the wrist in almost a straight line, then descends in a curve to the ankle, and from thence stretches to the point of the incurved tail in such a manner that this portion forms a triangular lobe. The skin, which is everywhere covered with thick white hair, connects also the digits of both fore and hind limbs as far as the roots of the sharp, cutting curved claws, but these digits, unlike those of the bats, are short. There is no opposable thumb or great toe.

One would link the flying-lemurs with the flying-foxes (*Pteropus*), if the dentition and the form of the skeleton, especially of the digits, were not different. In the upper jaw there is in the former a wide median gap or diastema, then on each side a quite small incisor placed very close to the next tooth beyond, then two sharp-pointed triangular teeth, the first of which, the larger of the two, is the canine, while the second is a premolar. After these there follow five sharp-pointed teeth, the cusps of which are in two rows. In the lower jaw there are three broad incisors divided into strips like the teeth of a comb, the two inner of which are placed horizontally, then again two sharp-pointed triangular teeth, the first the canine, the second a premolar, after which come another premolar, one with several cusps, and four molars which get worn away by use. It is the dentition of an insect-eater, which has adapted itself also to a vegetable diet. The dental formula is $\frac{1 \cdot 1 \cdot 1 \cdot 5}{3 \cdot 1 \cdot 2 \cdot 4} = 36$ teeth. The orbits do not form a complete bony ring as in the other Prosimii, but have a wide gap behind. The lower jaw is heavy and massive; the fore-arm very long and so also the fore-leg.

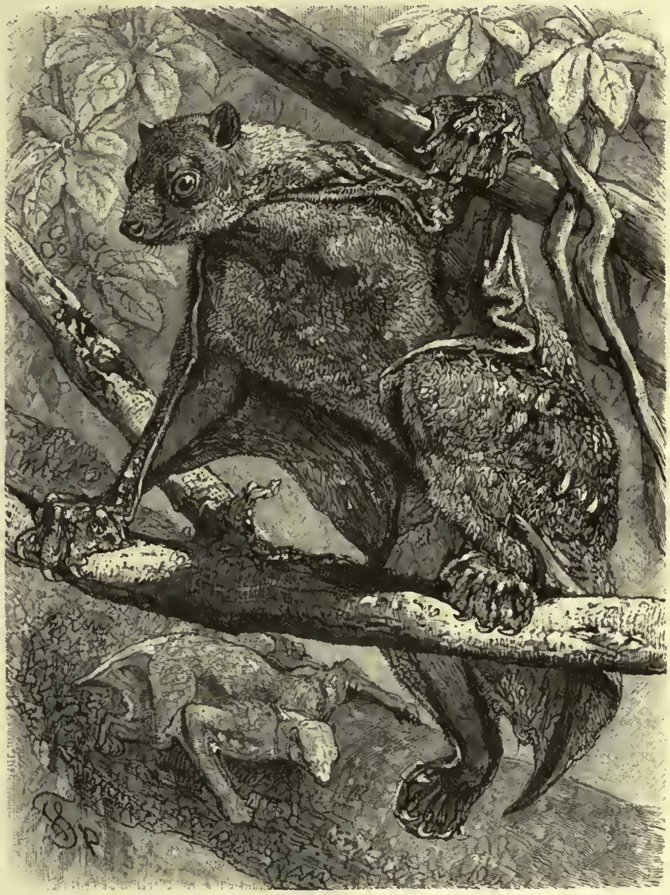


Fig. 36.—The Colugo or Flying-cat (*Galeopithecus volitans*). page 94.

The flying-lemurs sleep by day hanging

---

[1] The genus Galeopithecus is now usually included among the Insectivora, to which order it was first referred by Dr. Peters of Berlin, but according to Prof. Parker it stands in fact quite isolated, having no near relations whatever.—Tr.

head downwards by the hind feet, and enveloped in their patagium as in a mantle. They live indeed socially, but not in such large companies as the flying-foxes. They awaken at dusk and begin clambering about in the trees in search of their food, which consists largely of insects, larvæ, eggs, and small animals, but partly also perhaps of juicy fruits and leaves. They cannot exactly fly; but the patagium serves as a sort of parachute, with the aid of which they are able to make astonishing leaps from one tree to another. The ordinary colugo (*Galeopithecus volitans*) is represented in fig. 36. Whether several species can be distinguished is still doubtful. They inhabit the large Sunda Islands and extend as far as the Philippines, and are met with also on the mainland, especially in Siam and Cochin-China. They are, however, comparatively rare and not often observed.

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE PROSIMIANS.

The geographical distribution, as well as the origin of the Prosimii, present some extremely interesting problems, which indeed have not yet been completely solved.

All the Prosimii now living belong exclusively to the tropical and subtropical parts of the Old World, and indeed to three separate regions, which are sharply marked off from one another, having no genera nor even families in common. The East Indies and especially the Sunda Islands form the home of the loris, tarsiers, and flying-lemurs; West Africa is inhabited by the potto and angwantibo, the whole of Africa by the galagos; all the others, that is to say, all the numerous forms of indris and true lemurs, as well as the aye-aye, are confined to Madagascar.

This distribution may be held to point first of all to the fact, that Madagascar forms a zoological province altogether distinct from the continents, showing a greater amount of peculiarity than many now isolated regions, a peculiarity which, moreover, must date from the earlier Tertiary times, since it is likewise manifested in relation to other mammals. But further, one cannot help recognizing that the very varied forms of Prosimii must belong to several separate stocks which have been distinguished from one another since the beginning of the Tertiary period. The East Indian and West African types cannot be derived from the same stock as those of Madagascar, and all speculations as to the former existence of a continent, now largely submerged, but which, when it did exist, extended from the East Indies to Madagascar and the mainland of Africa, perhaps even to America, having the large East African island as its centre,—all speculations about this so-called Lemuria, from which the Prosimii, and then, as their descendants, the monkeys and the human race were supposed to have been distributed over the earth, at once fall to the ground, in face of the simple fact that the various types of the locally separate Prosimii can only by violence be united into one group.

Till a few years ago no fossil Prosimii were known; but recently their remains have been found in the Upper Eocene of France (Quercy), and in considerable numbers in the Lower Eocene of Wyoming in North America. But here we must probably distinguish two sets of discoveries.

The sole incontestable European prosimian has been found in the phosphorites of Quercy in Western France. It is so closely allied to the West African potto by the structure of its head and teeth that it can scarcely be held to form a separate genus. The African centre accordingly then lay more to the north. To this form, of which we possess the entire skull, the name of Necrolemur has been given.

But in addition to this, there have been found in the gypsum of Montmartre and in other places remains of small animals, in some cases as large as foxes, which were formerly referred, under the name of Adapis, to the Ungulata, but which, on careful examination, exhibit such close affinities to the Prosimii that a controversy is still carried on between the finders as to whether they must be referred to the one group or the other. These remains include some almost entire skulls; and this uncertainty at any rate shows that we have here to deal with transitional forms, whose relations are all the more difficult to determine since they occur along with the remains of genuine Prosimii, and accordingly cannot be the ancestors of the latter.

In North America the case is the same. Wyoming has yielded a large number of such transitional forms, which have been called Limnotherida; but besides these a small number of other forms, Lemuravida, which show much closer affinities to the lemurs.

Neither in the Old nor the New World have there yet been found in later strata any remains which can be shown to belong to the Prosimii. Both the transitional forms and the true Prosimii disappear with the Eocene, and in America both sets have quite died out, while in the Old World the true prosimian type has been continued to the present age. We must await the results of further investigations before we can decide the question of the true relations of the transitional forms, and, in particular, we must ascertain the structure of the limbs of these forms in order to determine whether they were analogous to those of the present Prosimii or to those of the Ungulates.

Combining the results of palæontological, geographical, and zoological investigation we can only say that the variously formed order of the Prosimii must have had also a varied origin, probably from marsupials, to which many features of their organization point, and that certain forms belonging to the order are among the oldest Tertiary mammals known. It is, at any rate, in the highest degree remarkable that types, which were so abundantly represented in North America in early Tertiary times, have quite died out there.

If this high antiquity of the Prosimii, reaching back almost to the oldest strata from which we have obtained any placental mammals, has been demonstrated by palæontological discoveries, this fact affords at the same time a proof, that the formation of hands, that is, of opposable thumbs or great toes, does not represent, as was formerly believed, a further development of the foot, but must rather be regarded as a more or less primitive structure.

But lastly, we may conclude from these facts that no very close affinity can be demonstrated to subsist between the Prosimii and the Simiæ, and hence between them and man. With the exception of the opposable first digits, which are, indeed, as we have seen, a widely distributed common feature, the Prosimii have not a single anatomical character in common with the apes and monkeys. The dentition, the most constant of all anatomical characters, associates them with the Insectivora; to include them among the ancestors of man is to defy all the principles of scientific investigation.

THE BATS

(CHIROPTERA).

Distinguished by the possession of wings formed by a membrane attached to the body, and commonly also to the hind-limbs and tail, and capable of being extended by the remarkably elongated digits of the fore-limbs; complete dentition; two pectoral mammæ; discoidal placenta.

The body in the bats is in general thick-set and compact, the neck short, the skull rather small than large, somewhat elongated. Owing to the remarkable development of various appendages of the skin, however, as well as to the broad muzzle, the head in the living animal appears to be rather large. The eyes depart from the general rule for nocturnal animals in being rather small, sometimes even very small; the ears are always large, often peculiarly developed; the nose is sometimes naked, and situated at the end of the snout, sometimes adorned in a singular manner with flaps of skin supported by cartilage.

The brain-case is mostly rounded, and frequently divided from the facial region by a marked constriction. The orbit is mostly continuous with the temporal fossa or depression at the temple, and it is only rarely bounded by a narrow external bony ring. The structure of the premaxilla is often very peculiar. Only in rare cases do the two premaxillary bones meet in the middle; for the most part they are separated by a wide interval, so that the upper incisors are placed quite to the side, and often they are reduced to small bony scales which scarcely cut the gums.

The dentition belongs to the insectivorous type, and even that of the flying-foxes, which we leave out of account in the meantime, can be derived therefrom. All the other bats may, without hesitation, be designated as flying Insectivora.

The number of the teeth varies in an extraordinary manner, from 24 to 38 for the total, but the numbers 32, 34, and 30 are those by which the total is most frequently represented. Twenty-three of the sixty-seven genera that have been distinguished, that is, more than one-third of the whole, have 32 teeth. Besides the original deviations, especially in the number of the molars, the distinctions chiefly depend upon this, that in many genera many incisors and premolars drop out very early, or are not replaced at the change of teeth. The incisors are mostly very small, in the upper jaw placed, as we have seen, to the side, and there also peculiarly apt to disappear. The canines, which are always present, are large, recurved, and provided with cutting edges, in many genera, as notably in the vampyres, very large and prominent; the premolars sharp and conical; the molars furnished with two or three pointed cusps, which are so arranged as to fit closely into one another, so that they do not get ground away by use, but are kept always sharp. The dentition is thus specially adapted to hold fast and transfix the prey. The milk dentition is very different from the permanent. The teeth are furnished with backwardly directed hooked points.—But we must not here try to enter on details.

The ear is always large, the flap mostly naked, and frequently, as in our long-eared bat (*Plecotus auritus*), developed to such an extent as to equal in length one-third of the body, and to be capable of being rolled up as in the galagos. The inner ear-covering (*tragus*) is always very large, often tongue- or spoon-shaped, and on it, as on the external flap, there are always borders and projections on the inner side which afford constant characters to distinguish species.

The structure of the wings deserves a more thorough examination. The breast-bone or sternum, to which the strong muscles for effecting the downward stroke of the wings are attached, is large, and is furnished with a broad pre-sternum or manubrium, and a long vertical longitudinal keel, which reminds us of the structure seen in birds. The collar-bones, which afford a support for the joint of the fore-limb, are large and strong; the humerus, or bone of the upper arm, is the largest and strongest bone in the whole body. The fore-arm is likewise very much elongated, but consists solely of the ulna, the radius being rudimentary. The wrist is very short, and is formed out of only a few small bones; all the five bones of the middle hand, or what anatomists call the metacarpal region, are present, but that of the first digit is short and thick, those of all the others long and thin. The first digit remains more or less free, is short and thick, and carries a large sharp sickle-shaped claw. The other digits are mostly without nails, and usually composed of two remarkably long and thin joints (phalanges). In most of the flying-foxes (Pteropus) the second digit is usually armed with a small claw. By means of these digits the wings are spread out or folded up, just as the cover of an umbrella is by means of the ribs. The membrane forming the wings begins as a fold of the skin at the neck, envelops the fore-limbs and their digits, and, getting attached to the sides of the body, is continued backwards to the hind-limbs, which, for the most part, it includes down to the ankle-bones, and then passes to the tail, which is sometimes left entirely free, sometimes just fringed with the membrane, and sometimes entirely inclosed by it.

This membrane, apart from that portion of it which is comprised between the elongated digits, repeats the structure of such parachutes as are met with in the flying-lemur, the flying-squirrel, and the marsupials, all outgrowths from lateral folds which occur in many embryos. The portion belonging to the hand, moreover, is likewise nothing else than the excessive development of a primitive embryonic condition. In all mammals hands and feet are at first little oar-shaped processes, within which the growing fingers lie embedded in the tissue, and connected to their extremities by skin. In mammals possessing fins or flippers (seals, whales, &c.) this embryonic condition persists, but in most mammals the digits grow out beyond the connecting skin, which, however, often remains to a greater or less extent as a web between the toes (otters, beavers). In the bats the digits grow to an extraordinary length, and carry along with them the connecting membrane, which thus persists as part of an organ of flight. The wing of the bats is thus a specialized form of the fin or the embryonic limb, and although it is a powerful organ of flight, yet it has no resemblance in structure to the bird's wing, which has arisen from quite different modifications.

The rapidity and ease of flight depend upon the length and sharpness of the wings, and this latter property is determined by the proportion of the fifth to the third or middle digit. Among our native bats the noctule (*Vesperugo noctula*) and the long-winged bat (*Miniopterus Schreiberi*) are in no way inferior to swallows in rapidity and strength of wing, or in the power of sudden turning, and like these, rise high in the air to fight even with storms. In them the ratio of the length of the fifth to that of the middle digit is respectively 10 : 18 and 10 : 17, while in the rather helpless horse-shoe bats (*Rhinolophus*), which keep fluttering about in the lower regions of the atmosphere, and in the water-bats (*Vespertilio dasycnema* and others) the proportion is only 10 : 12.

The flying membrane itself is always very thin, composed of two delicate layers of skin, between which run blood-vessels, elastic fibres, and a very remarkable nervous tissue. To the naked eye it appears perfectly hairless, while the rest of the body is thickly covered with hair, but it has, in fact, a large number of delicate little hairs scattered over it, which, as is proved by the little bundles of nerves at their roots, act as highly sensitive end-organs of touch.

The feet are constructed on the normal type, always short and powerful, the five toes quite free, and armed with strong sickle-shaped claws. When resting, the bats either hang by the feet with the head downwards or by the clawed thumb of the fore-limb. At the ankle there is usually developed a spur which is directed inwards, and is always very thin, but often, at the same time, remarkably long, and this spur serves to support the expanded membrane between the feet and tail.

Of the senses, that of touch is the most highly developed. Bats which have had their eyes sealed, or even picked out, fly about amidst outstretched threads and other obstacles without striking against them with as much ease and security as if they could see. In many species the small eyes are so hidden amongst the hair that keen vision is certainly impossible, and yet they can catch flying insects. Without doubt they are made acquainted with the presence of external objects by the sense of touch even before they come in actual contact with them. This sense is developed in all the naked parts—ears, nose, and flying membrane.

If the sense of sight is weak, that of smell must be regarded as almost equal to zero. Bats which are accustomed to milk and flesh are unable to find out these articles by the nose, and if a high development of this sense has been inferred from the size of the nasal appendages, that inference was based on error, for no animal smells with the outer nose, which is capable of receiving only impressions of touch.

Hearing, on the other hand, is extraordinarily keen and delicate, and, unquestionably, bats can hear tones which are inaudible to our ears. This is proved even by the voice of most of the native species; its pitch is so high that many persons cannot hear it at all, while the bat perceives it at great distances, and by means of it attracts and warns its fellows. Recently it has been rendered very probable that many insects utter sounds which man cannot hear, but which are, without doubt, audible to the bat. Many insects have a flight quite inaudible to man, by which, nevertheless, a bat is even awakened out of sleep.

The mental endowments of the bats can only be reckoned at a very low level. The brain has no convolutions, as is usually the case with small animals. The hemispheres of the large brain (the cerebrum) neither cover the mid-brain nor the cerebellum, and are accordingly only very slightly developed. Yet their capacities are adapted to the conditions of their existence. They show what seems like great ingenuity in selecting their retreats; they know their hunting-ground, if we may so speak, as accurately as possible. Some species can be tamed to a certain extent.

If their mode of life and their qualities are not accurately known, that is mainly because they are all nocturnal animals, and our European species, which are still those best known in these respects, hibernate. In tropical countries they are active all the year round.

For their winter retreats the bats seek out warm dark recesses sheltered from the wind, and in these they are often found together in enormous swarms. Caves, grottoes, clefts in the rocks, hollow trees, retired corners in buildings, unused chimneys, the spaces beneath roofs, and so forth are the places where they are chiefly to be found during this period of the year. Among buildings they naturally prefer old disused buildings where people seldom come. Such winter-quarters are often sought out by bats from distant parts all round. The different species mostly hang themselves up separately. The hardier forms, which have less dread of the cold, fly out earlier in the spring, and return later in the autumn, and place themselves nearer the entrances to the caves, while the other species retire further in. Before the beginning of the winter-sleep copious evacuations take place, and then the animals hang themselves up by the claws of the hind-feet with the head downward, and more or less enveloped by the wings. This occupation of the winter-quarters is not effected without a good deal of quarrelling, crying, and even biting. Frequently they even hang on by one another. As in all hibernating animals, the temperature gradually sinks, and the body, at first fat, becomes thin; the beats of the heart and the movements of respiration become less frequent, and consciousness is often lost to such an extent that the animals cannot be awakened except by warmth. Yet in this respect different species are very different from one another. Some have a comparatively light sleep, waking up again when there is but a slight rise of temperature, and sometimes even flying out, or changing their position, not without quarrelling. Others again sleep much more profoundly. In such winter-quarters the excrement of bats, in which are always to be found undigested remains of insects, legs, carapaces, wing-covers, &c., is heaped up to the depth of a foot or more, so that the accumulation can be employed as guano. During the hibernation the functions of the body, in particular the breathing, take place at the expense of the stored-up fat.

Frequently these winter-quarters are used by the bats as retreats by day, even during their period of activity in summer; but, for the most part, other summer-quarters are sought out, often at a great distance from those occupied during the winter, and then they are mostly occupied only by individuals of the same sex. Thus I once examined at Geneva retreats of the early-flying noctule, which were inhabited only by males, with only a female here and there, and which during the winter regularly stood empty. In taking off the roof of a six-storied house, to the space beneath which access could be obtained by only a single hole, from which the bats could be seen regularly flying out, so that there could be no difficulty in keeping all the occupants prisoners, seventy males were found with only two females. While in summer the noctule hunts about in the town of Geneva, and makes its retreats in corners about houses, one would seek for it there in vain in winter, since it then prefers hollow trees.

There is much that is peculiar in the mode of reproduction of these animals. The uterus is always partially divided, sometimes divided almost throughout its length, but, for the most part, as in birds, though not to the same extent as in them, the ovary and the horn or prolongation of the uterus on one side are imperfectly developed, so that the internal organs are not symmetrical. Most species bring forth only one young one at a time, but many frequently two. At the time of giving birth to her young the female suspends herself by the claws of the thumbs, and bending the tail inwards forms a sort of sack with the lower portion of the flying membrane, and into this drops her young. In the case of the horseshoe-bat the young one for a day or so clings on to two rudimentary eminences at the opening of the female pudenda, but in other species it at once crawls up to the two pectoral teats. The ovum and the embryo begin to develop in spring, and our species mostly usher their young into the world from the end of May to the middle of June. For a long period the young are carried about by the mother. The union of the sexes takes place in autumn before the winter-sleep, at least, in the case of adult bats—a fact now definitely ascertained. Only a certain number of young ones, which in the autumn had not reached the period of puberty, unite in spring; all the old ones unite in autumn. The semen remains in the uterus of the female in a state fit to fertilize the ovum all through the winter, and not till spring does the ovum become liberated from the ovary, and get impregnated, so that the embryo may begin to develop. Similar processes are observed in many other mammals, as, for example, in the roebuck.

The food of our bats while living in a state of freedom consists exclusively of insects and spiders, which they sometimes catch in flight, sometimes by dexterously snapping them up from the spots on which they are resting, while themselves flying. The great army of the mostly noxious moths or nocturnal Lepidoptera forms the bulk of their food, and hence bats must be regarded as remarkably useful creatures to man. They perform during the darkness the same service as is performed by the swallows by day, a service but imperfectly rendered by the small number of goatsuckers and small owls, which also destroy nocturnal flying insects. Bats ought, for that reason, to enjoy the same respect and protection as the swallows. Like all insect-eaters the bats are extremely voracious, being active during almost the entire night with only short intervals of rest; but their pursuit of insects and other prey is carried on chiefly just after sunset and before sunrise. A pause takes place about midnight. According to their powers of flight they take short rests between their different forays, or go on flying for hours together like swallows. Some pretend to have observed, that in all the rapid turns of their chase, which, however, is always carried on within a limited range, the bats go to work in a very dainty particular manner, and likewise exhibit much prudence. They are said, for example, to consume only the bodies of moths, allowing the wings to drop, and it is even related that a bat has spared a female in order to catch one after another the males who swarmed round her. It may be that the female crouched in a fissure in the bark of a tree in such a manner that the bat could not get at her. Many a fable is invented regarding the animal kingdom!

But though in a state of freedom it has never been observed that the native bats make use of any other food than that mentioned; in captivity it has sometimes happened that one has attacked the other, sucked out its blood, and then consumed it. Similar things have been observed in other animals also, otherwise very peaceable in their habits. On the other hand, it is a well-established fact that bloodthirsty bats do live in tropical countries. In hot regions their food is certainly more varied, and consists, on the one hand, of fruits, on the other hand of the blood of warm-blooded animals, especially birds. Bacon, and dead things generally, they never touch unless they have been trained to it.

The enemies of the bats are, above all, the owls, and next after these, such animals as seek them out in their hiding-places—martens, weasels, rats, and even mice. But, for the most part, they hang themselves up in places where climbing animals cannot reach.

The fur is mostly fine and thick. The hairs have a peculiar structure by which they can be recognized with certainty under the microscope. Wingless insects and mites usually swarm as parasites on this fur and even on the flying membrane. The colour of the fur is always dark, sometimes inclining more to gray, sometimes to black, sometimes to brown or fawn-colour, almost always uniform. Spotted or striped bats are very few indeed.

The number of genera is very large, above 60; that of the species which have been so far distinguished, upwards of 300.[1] They are distributed over the whole earth, wherever there is a sufficiency of insects, even reaching as far as the snowy regions round the poles and high up in the mountains. The grouping of the species in genera, and of genera in families, is extremely difficult in consequence of the varied nature of the dentition and the frequently unimportant character of the other differences; and on that account we have confined ourselves principally to our native European forms, taking into consideration only a few very peculiar forms belonging to more distant regions.

First of all, the order may be divided into two groups—the **Fruit-eating Bats** (Carpophaga or Frugivora) and the **Insect-eating Bats** (Entomophaga). The former is not numerous, being made up of the single family of the flying-foxes (Pteropida). The other group comprises all the rest.

THE FRUIT-EATING BATS

(CARPOPHAGA).

Flying-foxes (*Pteropida*).

With flattened masticating molars, and mostly with a clawed second digit on the fore-limb; snout long.

Natives of the Old World, Australia, and the South Sea Islands, these large bats, the largest species of which, the kalong, spans with outstretched wings a width of five feet, are mainly distinguished by their dentition, partly also by the structure of their wings; but with these distinctions are associated many other anatomical and embryological peculiarities.

The skull is long, the brain-case pear-shaped, separated from the facial region by a marked constriction, the orbits scarcely separated from the temporal fossæ or depressions at the temples, the snout projecting, the nose formed in the usual manner. The premaxilla is well developed, closed in the form of a bow under the cavity of the nose, and carries two small vertically placed incisors. There then follows a large sharp mostly recurved canine, which is immediately succeeded by a very small recurved premolar, which, however, frequently drops out or remains undeveloped. There next comes an interval without teeth, and then three molars, which decrease in size from before backwards; and finally a small tubercled tooth placed somewhat to the inside out of the series. In the lower jaw incisors and canines are similar, the premolar somewhat larger, and instead of three there are four molars, and behind these again the small tubercled tooth. The dental formula is thus $\frac{2 \cdot 1 \cdot 1 \cdot 4}{2 \cdot 1 \cdot 1 \cdot 5} = 34$. The form of the molars is extremely peculiar in both jaws. In the young animal they consist of two lateral triangular plates of enamel, which meet together, and are elevated at the middle and at both ends of the tooth. The enamel plates are separated from each other by a deep groove, and the teeth so formed present a distant resemblance to the molars of many ruminants. Seen from the side, these teeth appear to have only one triangular cusp, for the outer cusp is higher than the inner. In the adult animal the crowns of the teeth get so worn away that they exhibit a rounded grinding surface sloping down inwards.—It is thus not an original pure insectivorous dentition which the flying-foxes possess; the sharp canines and molar cusps contradict that; but it becomes converted into a dentition of that kind by use, and accordingly it may be surmised that the young flying-foxes feed on

---

[1] Mr. G. E. Dobson in his treatise on the Chiroptera describes 400 species distributed among 80 genera.

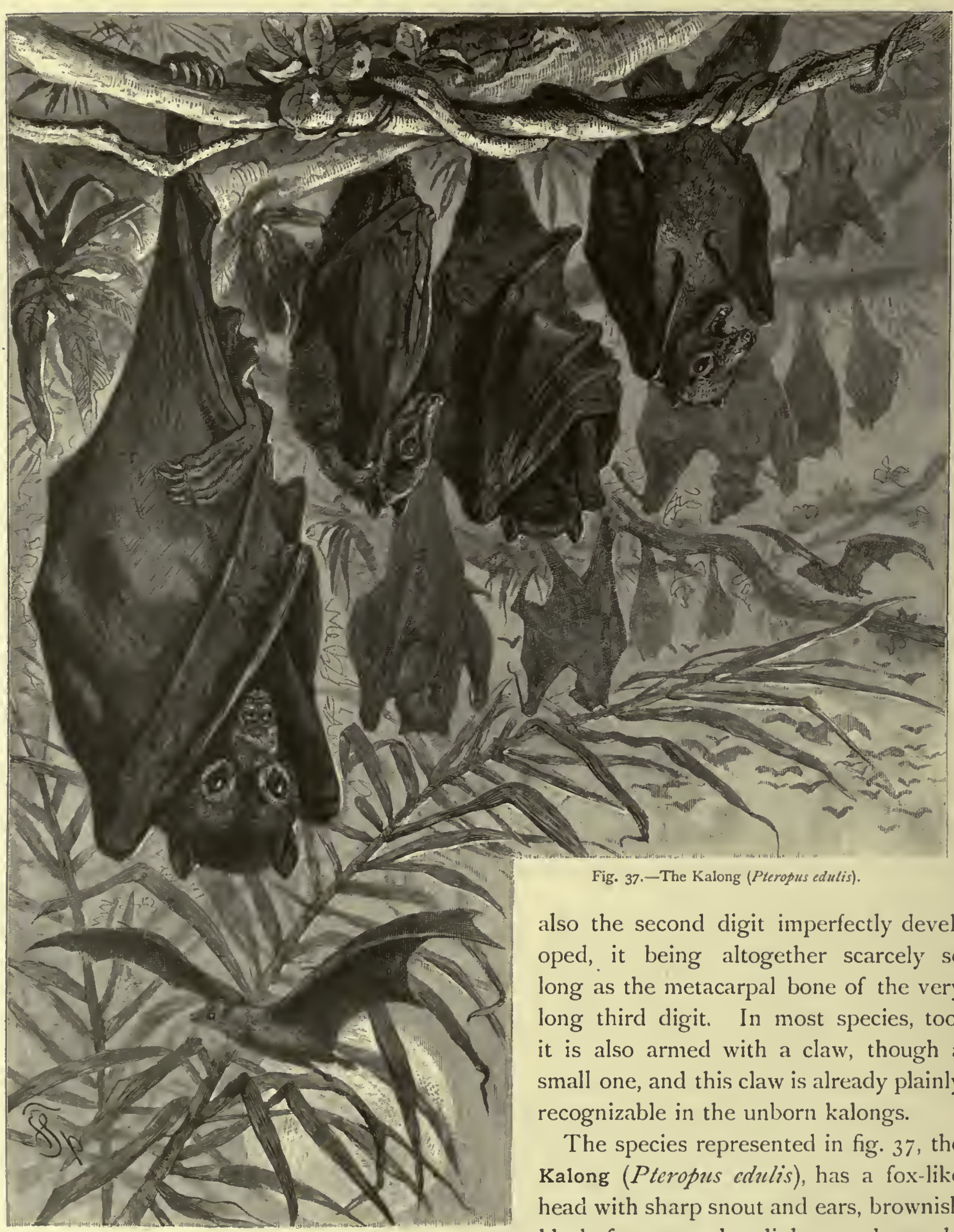


Fig. 37.—The Kalong (*Pteropus edulis*).

insects and small animals, and only later adopt a vegetable diet.

As in all bats, the strong thumb is quite free from the flying membrane, and is armed with a sickle-shaped claw; but, unlike other members of the order, the flying-fox has also the second digit imperfectly developed, it being altogether scarcely so long as the metacarpal bone of the very long third digit. In most species, too, it is also armed with a claw, though a small one, and this claw is already plainly recognizable in the unborn kalongs.

The species represented in fig. 37, the **Kalong** (*Pteropus edulis*), has a fox-like head with sharp snout and ears, brownish black fur, somewhat lighter underneath, and almost black wings, which merely fringe the hind-limbs. The tail is altogether wanting. It lives in large flocks on the Sunda Islands as far east as Timor, and also passes over to the continent by way of Malacca. By day it hangs on trees by one foot, as

THE UNIVERSITY OF CALIFORNIA

shown in the illustration on the previous page, preferring such trees as have horizontal branches; and often enormous crowds of them are to be found in that position together. They do not particularly seek for shade or darkness, but they are so wrapt up in their wings that it seems as if hundreds of colossal pear-shaped fruits were hanging from the trees.

About dusk, or even before it, they fly away in search of their food, which consists not only of fruits but also of small mammals and birds, and even of fishes. Trustworthy observers have seen kalongs hovering like falcons over ponds in which small fish were playing, and then, darting down upon the fish, seize them with their feet, carry them away, and consume them. In their native countries they are often snared in nets. Their flesh is said by some to have, when macerated, somewhat of the taste of hare's flesh, by others to have a disgusting taste like that of foxes. In some parts the captive animals are fed and reared, but in others very few eat them.

In a state of freedom they live together peaceably, and quarrels and fights, always accompanied by screeching noises, only occur in the seeking out of sleeping-quarters and at the pairing season. At the cry of wounded kalongs their companions assemble together, apparently to afford help.

Kalongs have been brought to Europe repeatedly, but even those which I saw in London, where they were kept in a roomy hall in which they could fly about freely, did not survive long. Most of them were apt to bite, but some were good-natured.

Allied genera with a short tail (Cynonycteris) occur in Africa, among other places in Egypt.

A graphic description is given by the celebrated buccaneer and naturalist William Dampier, of the setting out of these large bats on their nightly expeditions as observed by him in the Philippine Islands. The bats were found in "incredible number" on a small low woody island, not above a mile in circumference, about a mile from the shore of a larger island. "In the evening as soon as the sun was set, these creatures would begin to take their flight from this island, in swarms like bees, directing their flight over to the main island, and whither afterwards I know not. Thus we should see them rising up from the island till night hindered our sight, and in the morning, as soon as it was light, we should see them returning again like a cloud to the small island till the sunrising. This course they kept constantly while we lay here, affording us every morning and evening an hour's diversion in gazing at them and talking about them."

Along with this it is interesting to read an account by another observer of the mode in which they take up their quarters for the day. "From the arrival of the first comer until the sun is high above the horizon, a scene of incessant wrangling and contention is enacted among them, as each endeavours to secure a higher and better place, or to eject a neighbour from too close vicinage. In these struggles the bats hook themselves along the branches, scrambling about hand over hand with some speed, biting each other severely, striking out with the long claw of the thumb, shrieking and cackling without intermission. Each new arrival is compelled to fly several times round the tree, being threatened from all points, and when he eventually hooks on he has to go through a series of combats, and be probably ejected two or three times before he makes good his tenure."—Tickell, in a memoir published in the *Calcutta Journal of Natural History*, quoted by Jerdon in his *Mammals of India.*

THE INSECT-EATING BATS

(ENTOMOPHAGA).

Our native bats all belong to this group, in which the molars have sharp cusps fitting into one another, a short snout, and only one claw on the wing-limb, namely, on the first digit or thumb. Two families are distinguished.

True Bats or Vespertilionidæ (*Gymnorhina*).

The simple nose at the extremity of the snout without leaf-like appendages.

This, the most numerous family, is distributed over the whole earth, and although most abundantly represented in hot climates, is to be found even in the polar regions and high up in the mountains. The snout is very short, the premaxillary bones placed laterally, so that a deep median gap separates the upper incisors on the different sides of the jaw; the ears are almost always large, membranous, and naked, and the inner ear-flap, the tragus, is developed in the form of a tongue- or spoon-shaped ear-covering.

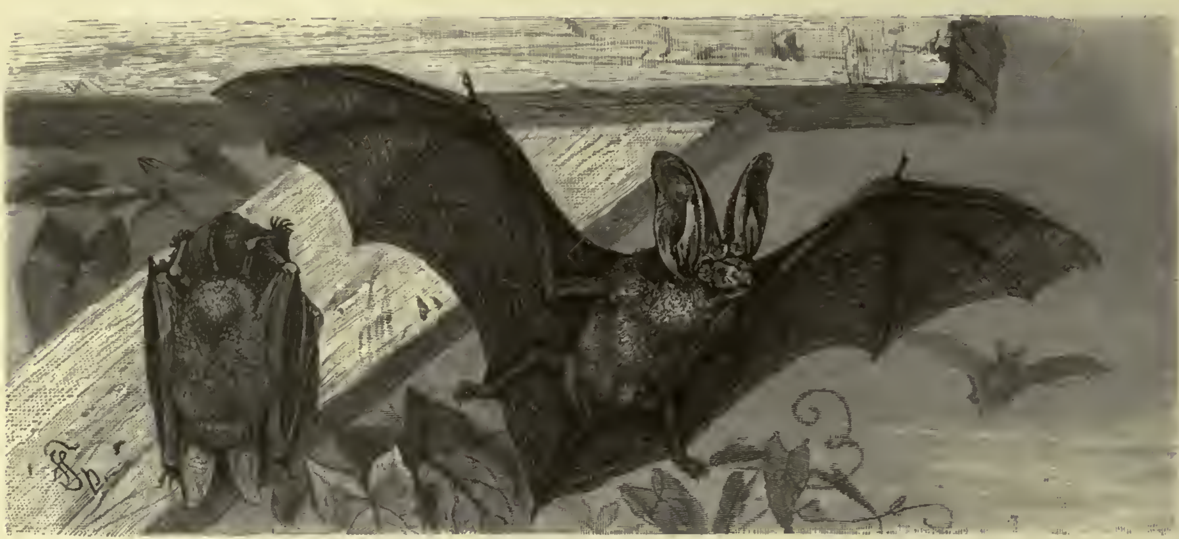


Fig. 38.—The Long-eared Bat (*Plecotus auritus*).

To this group belongs the **Long-eared Bat** (*Plecotus auritus*) of Europe, fig. 38.

The skull is highly arched, the facial region attached to the rest of the skull at an angle. On both sides of the median gap or diastema in the upper jaw stand two small incisors, which are followed by a strong recurved canine; then come two single-cusped premolars, and three molars with several cusps. In the lower jaw six incisors are crowded together in the space corresponding to the diastema in the upper jaw, and after the canine follow three single-cusped premolars, and the same number of molars with several cusps. The dental formula is thus $\frac{2 \cdot 1 \cdot 2 \cdot 3}{3 \cdot 1 \cdot 3 \cdot 3}$ $= 36$ teeth.

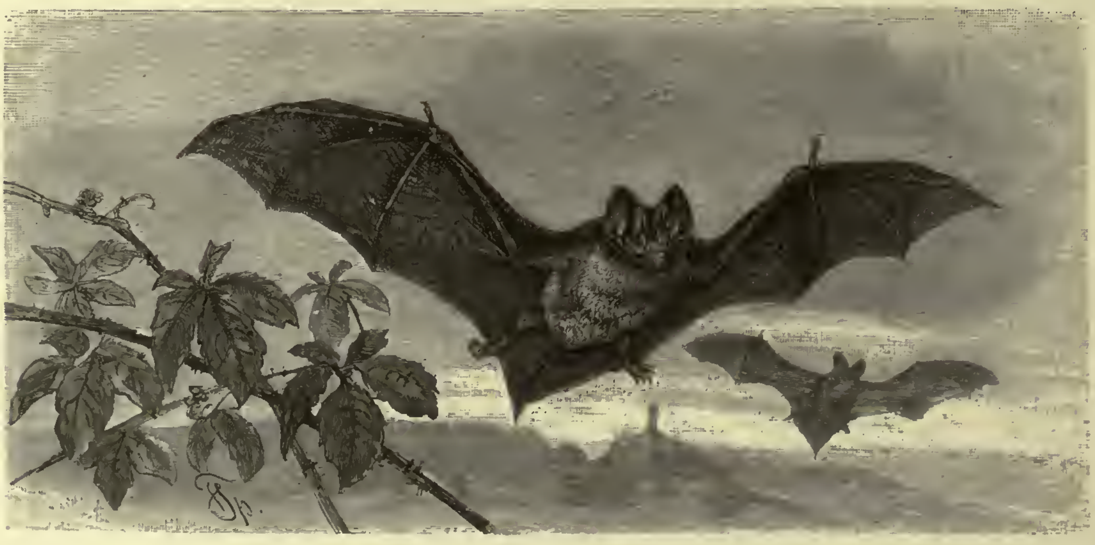


Fig. 39.—The Barbastelle or Pug-nose Bat (*Synotus barbastellus*).

The large papercornet-shaped ears strike us at the first glance. They measure more than two-thirds of the whole length of the body, and when seen in certain positions appear like two large thick horns. They are thin and membranous, and are fused together on the crown of the head. The external margin runs down almost to the corner of the mouth. The inner ear-covering or tragus is long and tongue-shaped; the eyes very small, the muzzle flat; the wings short, rounded; the point of the tail projects beyond the flying membrane.

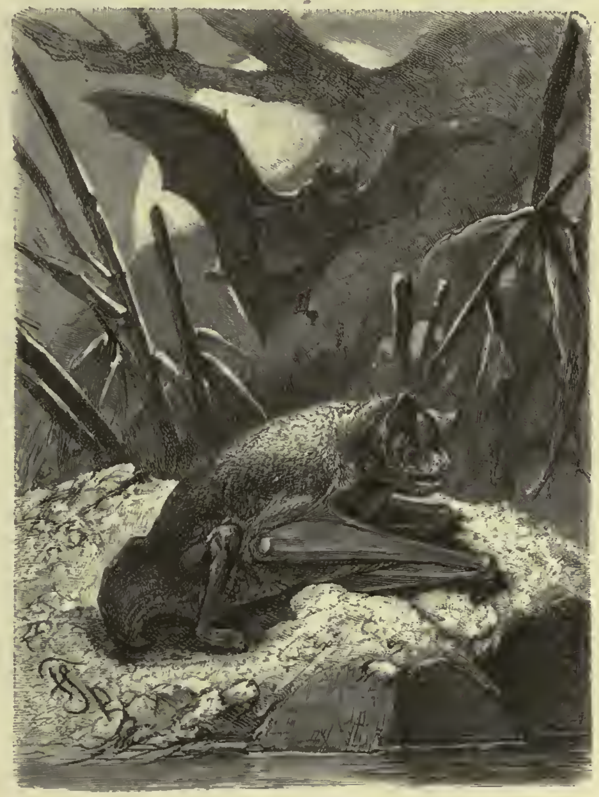


Fig. 40.—The Water-bat (*Vespertilio Daubentoni*).

This species is met with throughout Europe within the limits of the wooded region, and reaches as far as India. It flies high with a fluttering movement of the wings, and in flying generally rolls up its ears in such a manner that they resemble ram's horns. Its favourite hunting-ground is in open spaces, and about the roads in woods and groves. It appears only late in the year, and comes out late in the evening. It usually passes the summer in hollow trees, the winter in buildings. It stands cold well, and survives in captivity.

The **Barbastelle** or Pug-nose Bat (*Synotus barbastellus*), fig. 39, resembles the former species in the fusion of the ears on the crown of the head, but not in the size of the ears. The genus has one premolar less than the previous in each half of the lower jaw, and accordingly only 34 teeth. The short but very broad ear has a peculiarly curved expanded outer margin, the inferior portion of which extends to the cheek between the eye and the angle of the mouth. The wings are long and slender, the colour of the fur almost black, and the power of flight great both in respect of endurance and capacity for rapid turning. This species stands the cold very well, comes out early, fears neither storm nor rain, and is to be found high in the mountains, wherever there are human dwellings, since in these it prefers to pass the winter. It has a span of about one foot or rather more, survives in confinement, and can even to a certain extent be tamed.

The typical bats forming the genus Vespertilio, to which the **Common Mouse-coloured Bat** (*V. murinus*) and the **Water-bat** (*V. Daubentoni*), fig. 40, belong, are distinguished by having the largest number of teeth which bats can have; namely, in each half of the upper jaw two, of the lower, three incisors, one canine, three single-cusped premolars, and three molars with several cusps. Dental formula $\frac{2 \cdot 1 \cdot 3 \cdot 3}{3 \cdot 1 \cdot 3 \cdot 3} = 38$ teeth. The snout is sharper and longer than in the previous species, the ear sometimes longer, so as when laid flat to reach beyond the point of the nose, as in the mouse-coloured bat, sometimes shorter as in the species represented in the illustration. These typical bats, of which there are seven species in Europe, are very sensitive to cold and rain, have a long and very profound winter-sleep, leave their winter-quarters late in the year and retire again early, in flying keep near the ground, fluttering their short broad wings and showing little power of rapid turning. The mouse-coloured bat spends the winter and the day exclusively in buildings, and is one of the worst of fliers. Much better powers of flight are possessed by the water-bat, which mostly pursues midges and gnats immediately above the surface of the water, near which it prefers to remain in summer. It flies out early in the morning, and is found beside lakes even at a height of upwards of 3000 feet above sea-level. It spends the day, and rests at intervals during the night, in hollow trees or holes in the wall in the vicinity of water. Its winter-quarters are in hollow trees often pretty far from its hunting-ground.

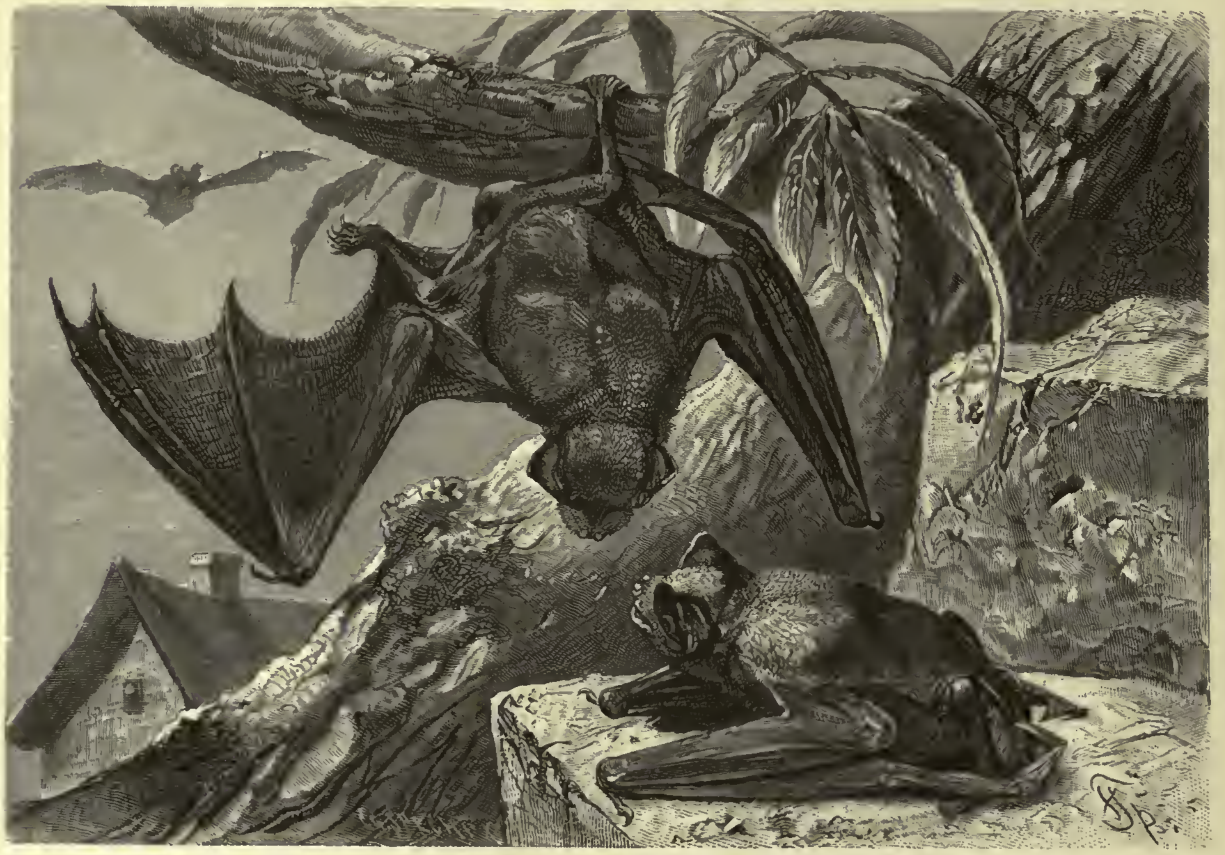


Fig. 41.—The Noctule (*Vesperugo noctula*).

The most enduring and expert fliers among the bats of Europe are the members of the genus Vesperugo, a genus with long skull, sharp and narrow wings, only two premolars above and below, but large canines. Dental formula $\frac{2 \cdot 1 \cdot 2 \cdot 3}{3 \cdot 1 \cdot 2 \cdot 3}$ = 34 teeth.

The ears are always distinct, rounded, shorter than the head, the tragus broad, spoon-shaped, the tail completely inclosed by the flying membrane. To this genus belong the smallest and the largest species of our native bats. The largest, which has a span of about 16 inches, is the **Noctule** (*Vesperugo noctula*), fig. 41. It has a brownish-red body and black wings, short broad ears, comes out very early, mostly before sunset, and hunts high in the air with rapid swallow-like turns in its flight. It has great power of sustaining flight, and is very voracious; smells strongly of musk, and usually the female brings forth two young ones at a birth. The winter-sleep lasts long. In summer, as above stated, the sexes usually live apart, not uniting till autumn.

Still more powerful and more capable of sustaining flight is the **Pipistrelle** or Dwarf Bat (*Vesperugo pipistrellus*), fig. 42, with small sharp ears, narrow tragus, and body of a reddish colour like that of the roebuck. It prefers narrow recesses in buildings and trees, cares little for cold, snow, rain, or wind, wakes early and easily out of its winter-sleep, flies about sometimes in dull but warm winter days, and with as much expertness and agility as its large cousin; easily accustoms itself to captivity; and, like the noctule, brings forth two young at a birth.

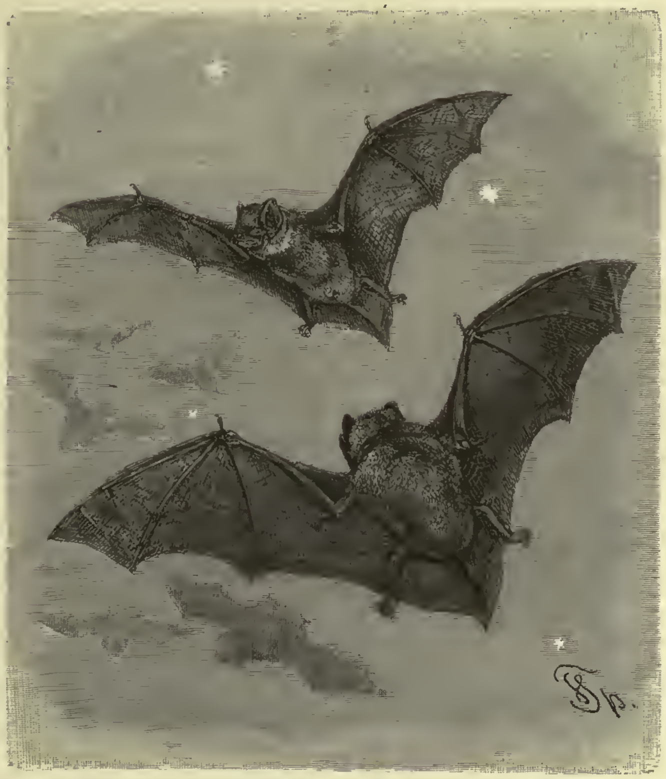


Fig. 42.—The Pipistrelle or Dwarf Bat (*Vesperugo pipistrellus*).

While the other bats are rather stationary, the Vesperugos undertake long migrations, and it seems to be proved regarding a species, whose true home is in the north, and which never advances further south than the Harz Mountains, the *Vesperugo Nilsoni*, that its migrations extend from the Russian Baltic provinces, where it passes the winter and early summer, to the shores of the White Sea, where it appears in crowds towards autumn.

Leaf-nosed Bats (*Phyllostomata*).

With membranous appendages to the nose, mostly supported by thin plates of cartilage.

As already observed, this sometimes simple, sometimes rather complex nasal appendage has nothing to do with the sense of smell, but is only the seat of a delicate sense of touch. This group, very rich in genera and species, is but sparingly represented in our part of the world, and is specially abundant in the tropics of both hemispheres. The food is frequently composed of fruits and the blood and flesh of warm-blooded animals besides insects.

As links of transition connecting the two families we may regard those genera and sub-families in which the nasal appendage has only a small extent and a simple form. Among these is the **Flap-nosed Bat** (*Rhinopoma microphyllum*), fig. 43, immense numbers of which inhabit natural and artificial caves in Lower Egypt, where by their very abundance, by their manner of fluttering about, and by the stench of the frequently foot-deep accumulations of their excrements, they constitute a material hindrance in the exploration of the ancient monuments. This species is a small mouse-coloured form, with pretty long wings, and with the lower part of the legs and also of the tail quite free, the latter projecting in the form of a thin naked pointed rod to a length as great as that of the whole body. The ears are of moderate size, the tragi narrow, small, the nose somewhat proboscis-like, and terminating in a small disk pierced by the nostrils, and rising above into a short flabby point. The nostrils can be quite closed as in diving animals. There are only 28 teeth; in the upper jaw one incisor, one canine, one premolar, and three molars; in the lower, two incisors, one canine, two premolars, and three molars. Dental formula $\frac{1 \cdot 1 \cdot 1 \cdot 3}{2 \cdot 1 \cdot 2 \cdot 3} = 28$. The premaxilla is complete and without a median interval.

Much more developed, though still simple, is the nasal appendage in the notorious and numerous family of the South American leaf-nosed bats or vampires, the largest species of which, the **True Vampire** (*Phyllostoma spectrum*), a species with a span of 28 inches, is represented in fig. 44. The nose-leaf exactly resembles the point of a halbert. It has a broad crescent-shaped base, the ends of which are directed upwards. In the middle of the concave edge of this base are situated the nostrils, which are small. From the nostrils a middle ridge rises to the point of the leaf which proceeds from the horns of the crescent. The head is short and thick, the ears pretty large, spoon-shaped, with small hairy tragi; the thin lips of the wide mouth have warty projections on them, which perhaps play a part in the operation of sucking. The tongue is short, and scarcely protrusible.

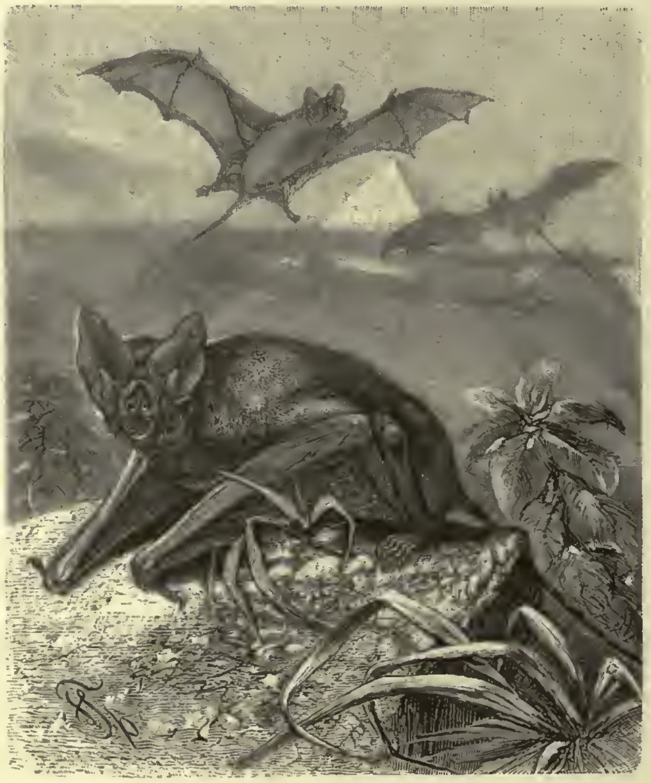


Fig. 43.—The Flap-nosed Bat (*Rhinopoma microphyllum*). page 107.

This family, occurring only in South America, is distinguished by the peculiar character of its dentition. For the most part there is one small but broad incisor with a notched chisel-shaped crown in each half of the upper jaw; many genera have two. The canines are very long, especially in the lower jaw, recurved, very sharply pointed, and with sharp cutting edges. Then follow generally two single-cusped premolars, and three molars with several cusps, the last of which is very small. The number of the premolars likewise varies. The dental formula of the genus Phyllostoma is $\frac{2\cdot 1\cdot 2\cdot 3}{2\cdot 1\cdot 2\cdot 3}=32$. In many species the tail is altogether wanting; in others it is present, sometimes longer and sometimes shorter, and on this difference, as well as on the differences in the structure of the teeth, are founded the different genera.

From the many contradictory accounts relating to these animals, which are still the subject of a variety of fables, we seem to be able to gather so much at least, that their diet is a very varied one, differing in different circumstances and in different regions. Most of all they seem to prefer insects, and then juicy fruits, and where these are present in sufficient abundance they appear neither to attack the lower warm-blooded animals nor man. But when this kind of food is not to be had, mammals and birds must make up for this defect. They approach sleeping animals and men so noiselessly that these are not awakened, and then begin sucking at some naked part, preferring in man to attack the toes when seen projecting beyond the blankets, these parts being almost insensible from cold. They then pierce the skin with their small notched incisors, making a minute wound like that of a leech, a wound that continues to bleed for a longer or shorter time according to the constitution of the person bitten. The results of these bites and the subsequent loss of blood have been enormously exaggerated, and careful inquirers, who were bitten themselves, have very reasonably drawn attention to the fact

UNIVERSITY OF CALIFORNIA

that in many parts of South America, where vampires are so numerous, cattle could not be kept at all if the food of those creatures consisted solely of blood. Martin made some decisive experiments in a house standing by itself, where he kept in a well-closed room various birds and mammals along with some vampire-bats. The window was latticed so as to admit insects, and a bunch of bananas hung from the ceiling. "Now as long as the fruits lasted and insects had free access, the vampires lived on this food. But when the window-shutters were closed and the admission of insects thus prevented, it was always found on the following morning that some birds lay on the floor deprived of their blood, and dead. On the morning next after the birds were devoured. Only after the third or fourth night were traces of blood seen on the mammals." From this it would appear, therefore, that it is hunger that makes the vampires bloodthirsty. We may, however, point out this, that in this case, as in the case of some other animals, it may perhaps happen that man, for example, is attacked in certain districts, but not in others.

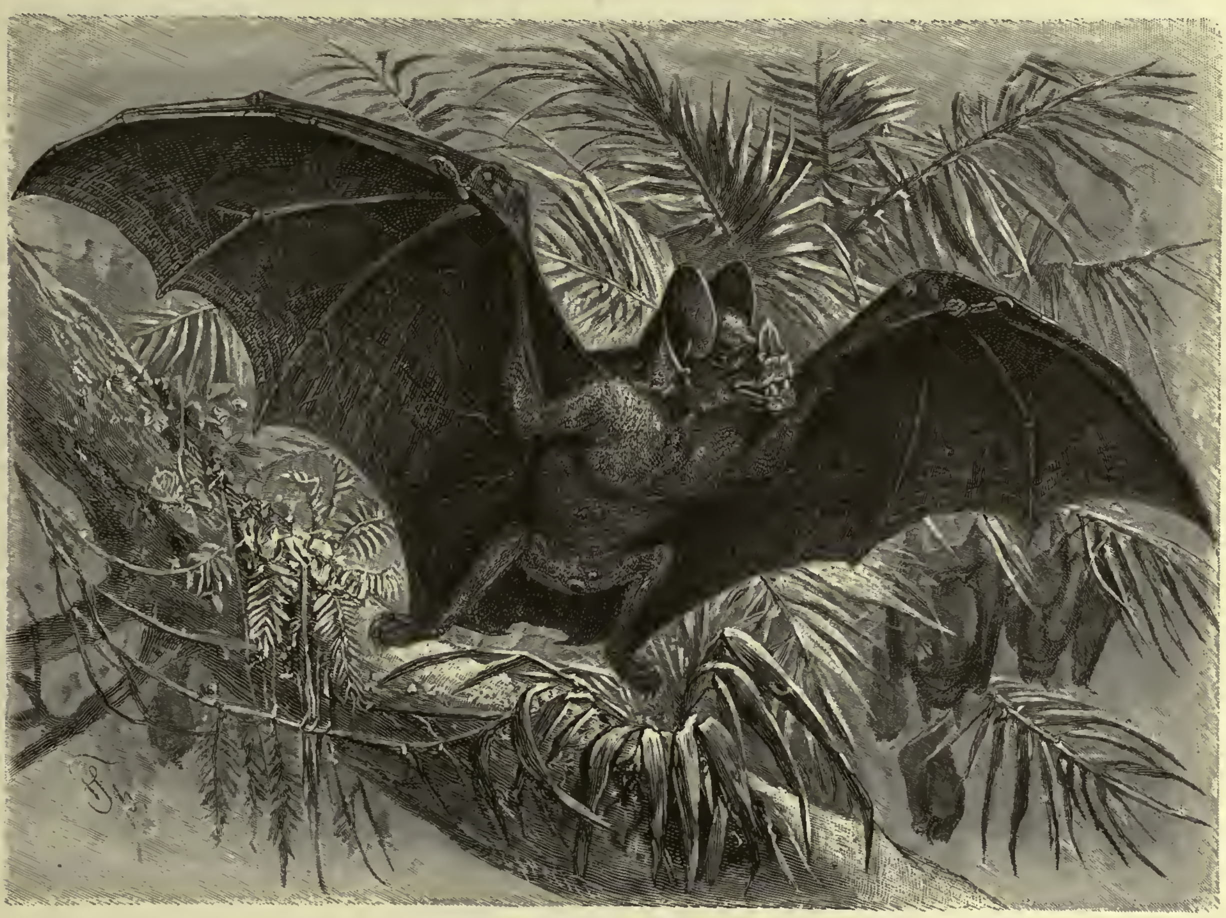


Fig. 44.—The Vampire Bat (*Phyllostoma spectrum*).

The **Horse-shoe Bats** of the Old World, forming the genus Rhinolophus, have a nasal appendage of the most complicated structure. It rests upon a horseshoe-shaped leaf running forward to the end of the snout, and containing the nostrils in deep pits in the middle of its concavity. The nostrils are surmounted by a narrow lancet-shaped process, behind which rises a second larger process of the same form, having several deep pits at its base. The ears are of middle size, narrowed above to a point, the tragus broad, the dentition marked by the unusually large gap in the middle of the upper jaw, in consequence of which the small incisors are placed wholly at the side.

The canines are large. The dental formula is $\frac{1 \cdot 1 \cdot 2 \cdot 3}{2 \cdot 1 \cdot 3 \cdot 3} = 32$ teeth. The wings are short and broad, the short tail included within the flying membrane which terminates behind in a right angle, or nearly so. The fur is light gray.

To the north of the Alps two species are common, the **Lesser Horse-shoe Bat** (*Rhinolophus hipposideros*), scarcely larger than the dwarf bat, and the species represented in fig. 45, the **Greater Horse-shoe Bat** (*R. ferrum-equinum*). Both are bad fliers, fluttering about near the ground, both are very sensitive to cold and rain, and have their retreats in caves, dry cellars, and beneath the rafters of houses. In a state of freedom they live entirely on insects. In captivity they sometimes show a certain amount of bloodthirstiness, and eat up other bats.

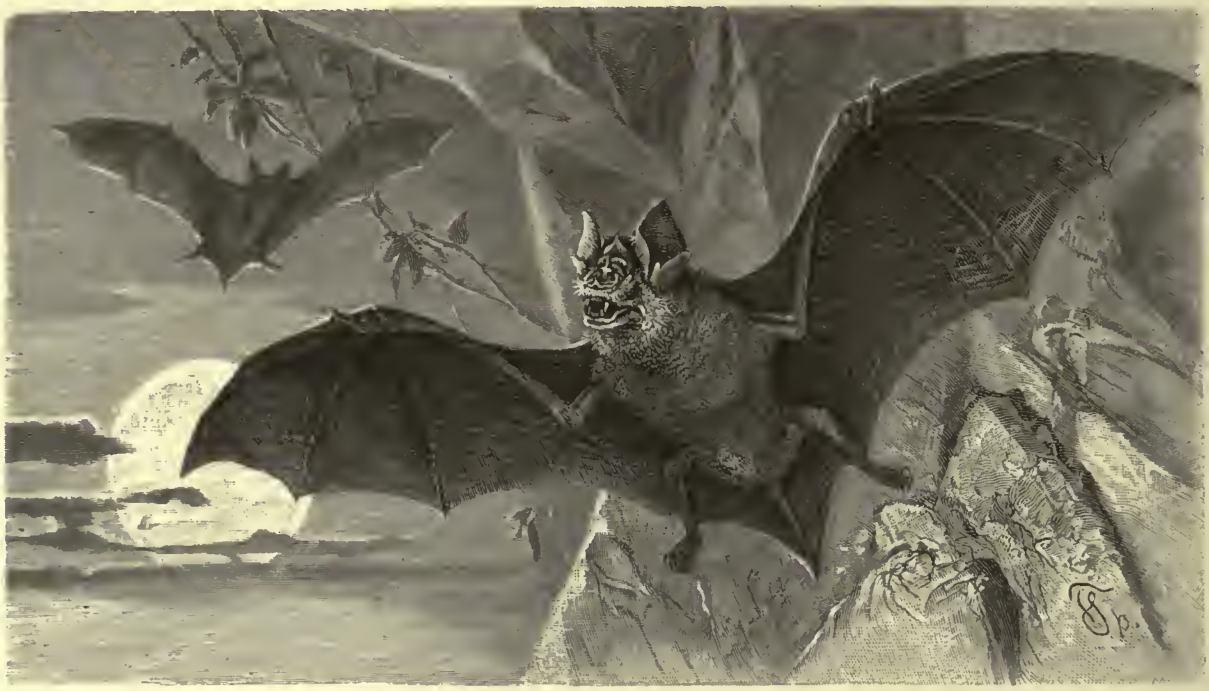


Fig. 45.—The Greater Horse-shoe Bat (*Rhinolophus ferrum-equinum*).

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE BATS.

The geographical distribution of the bats presents for two reasons a somewhat confused picture: first, because their natural arrangement in families traceable to a common type is still far from having been satisfactorily accomplished; and, secondly, because their power of flight, which, as we have seen, even at the present day, makes long migrations possible, must necessarily have contributed to enlarging their domains, and thus to obliterate the evidence as to their original seats. Some not uninteresting facts may, however, be noted.

The fruit-bats are spread over the whole of the tropical and subtropical parts of Australia and the Old World generally, but are altogether absent in the colder parts of the temperate zones and in America. From Central Africa they extend to Egypt and even to the shores of the Mediterranean, from India to Southern China and Japan, and they are spread over the whole of Australia and the South Sea Islands as far as the Samoan group, with the exception of the Sandwich Islands and New Zealand. Unquestionably this wide distribution is in a large measure due to migrations; perhaps some species have even been transported by man from one island group in the Pacific Ocean to another; but their powers of flight are so great that they were no doubt able to cross the intervening seas without other assistance.

Both smooth-nosed and leaf-nosed bats are spread over the whole world wherever there are insects enough for their food; and only in the case of the latter group can any sort of local limitation be noted. Among these the true horse-shoe bats are altogether excluded from America, the vampires, on the other hand, almost entirely confined to South America, only one species pressing as far north as Southern California. Tropical South America is thereby, as well as by the absence of flying foxes, shown to be an originally isolated region.

Concerning the **derivation** of the bats as such from older types, palæontology affords us no information whatever. The remains found in the more recent, and especially in Quaternary deposits, belong, except for slight variations, to genera and species still living, and the oldest bat yet discovered, that found in the Eocene gypsum of Montmartre, and accordingly in an early deposit for placental mammals, is closely allied to the genus Vespertilio. The great variety of the genera now living, and the wide distribution of individual types, are just as strong evidence of the great age of the bats as the structure of their dentition, which connects them immediately with the insect-eating marsupials, and even as the form of the wings themselves, which, as has already been shown in detail, are merely a special development of an embryonic, and consequently very primitive character. Looking at these relations we could not be very much surprised if it should turn out some day that transitional forms were found connecting the flying-bats with swimming ancestors, without there being any line of development through four-footed land animals. These, however, are only conjectures, for so far the structure of the bat's wing stands by itself without any analogue to place beside it. Only that of the flying reptiles, the pterodactyls, presents some interesting points of comparison, while the bird's wing, in which we can see the result of a gradual transformation of a reptilian foot, has arisen out of totally different conditions.

THE INSECT-EATERS

(INSECTIVORA).

Small plantigrade animals with a discoidal placenta and all three kinds of teeth; mostly five clawed toes on all four feet.

The nocturnal habits of these small animals, the largest species of which is about equal in size to a marten, withdraw these animals from ordinary observation, but not for the most part from unjust persecution. And yet these animals are in most cases important allies of man through their incessant hunt after insects, snails, worms, and all kinds of vermin. One may say with justice that they pursue upon and under the earth, even indeed in the water, the chase which the bats carry on in the air. If the differences in structure due to adaptation to flight were not so great, the bats and the insectivores would undoubtedly be united into a single great division of the mammals.

The adaptation to various habits of life has been able to exert all the more influence on the whole bodily structure of the Insectivora, since they belong to the oldest mammalian stocks which we are acquainted with, and at the same time represent one of the lowest grades of organization possible in ordinary placental mammals.

The **bodily form** varies within very wide limits, from the elegant little tupaias and elephant or jumping shrews (Macroscelides) to the shapeless golden moles (Chrysochlorida), which seem like a short thick sausage. It has been justly observed that these bodily forms repeat those of certain groups of the rodents. The members of the genus Cladobates are somewhat like the squirrels, the elephant-shrews somewhat like the jerboas, the shrews proper not unlike mice.

The mostly thick **fur** presents a large number of transitions, from the soft thick silky fur of the moles to the spiny coat of the hedgehogs.

The **head** is mostly small, conical, often even drawn out into a pointed mobile proboscis, at the end of which the nostrils open. It mostly passes over into the neck without any clear demarcation. The organs of sense are very variously formed. The eyes are for the most part least developed, especially in the genera living under the earth, some of the members of which are quite blind, inasmuch as the skin covers the underlying pupil without having a slit to form eyelids. The ears are mostly very small or even entirely absent. Scarcely ever do they exhibit those striking forms which are met with in the bats. The senses of touch and smell, on the other hand, are both highly developed, and in most species are united in the mobile proboscis.

The **brain** is for the most part very small, and in respect of internal structure stands on a much lower level of development than that of any other placental mammals. All those parts which in most of the other mammals are more or less covered by the hemispheres of the great brain (the cerebrum)—the parts called the olfactory lobes, the corpora quadrigemina, and the cerebellum—remain among the members of this group, as among the marsupials, uncovered. The mental qualities of these animals, in accordance with this low structure of brain, are little developed.

This small insignificant brain lies in a small brain-case, which even remains in places membranous at the base, and only seldom, as in the hedgehogs, develops crests and ridges for the attachment of the muscles. Usually this brain-case is prolonged without any constriction into thin, weak, long jaws. In many cases even the jugal arches which support the jaws are wanting, as also bony orbits, and these even when present are always incomplete.

These weak jaws, moreover, have a very remarkable **dentition**, which cannot be expressed by any general formula. There are indeed always incisors, canines, and molars, but their number, position, and form vary so greatly that investigators have not been always able to agree as to the character of certain teeth.

In many genera all the teeth are separate from one another as in reptiles, and in most only the molars are arranged in close series, the others standing isolated. In many cases the total number of teeth amounts to 44, which appears to have been the normal number of the old mammals. The total number may, however, fall as low as 30. This variety is likewise exhibited in respect of the form of the teeth.

Incisors, canines, and premolars often agree with one another in form and size, and present the form of a pointed cone or a slightly curved fang. In other cases we find a large pyramidal or recurved incisor taking the place of the canine, while in others again the incisors of the upper jaw may even be altogether wanting. The lower jaw frequently carries horizontally placed incisors, and in other cases the incisors in both jaws stand in closely set rows as in the Carnivora. A projecting recurved canine is met with only in the tanrecs. In most of the other members of the order the canine resembles an incisor in form and size, or agrees closely with the premolars in external form and in the possession of two roots. The premolars, which are often very numerous, always have a pointed cusp, but by the gradual appearance of lateral tubercles and gradual increase in size, pass over into true molars so imperceptibly that no hard-and-fast line can be drawn between the two. The remaining molars, finally, almost always possess three or four sharp cusps, and in the upper jaw are always broader than in the lower. The grinding surface of these teeth presents the form of a reversed **W** or **V**, the points of which, directed inwards, rest on a sharp and narrow heel.

This whole dentition accordingly is admirably adapted for the transfixing and retaining of the prey, but not for dividing or even for chewing it. It is altogether different from that of the Carnivora, with which the Insectivora were formerly combined. It is distinguished by the absence of constant formulas, by there being no well-marked carnassial tooth, and by the poor development of the canines. It can only be compared with the dentition of the bats and some living or fossil marsupials. With respect to the position that must be assigned to the Insectivora in a natural classification of mammals, these facts are of great importance.

The structure of the feet in the Insectivora presents many variations due to the habits of life. The tupaias living on trees have elegant long limbs, the hind ones being, as in all climbing animals, more powerful than those in front. This disproportion becomes still greater in the elephant-shrews, in which the ankle is remarkably elongated, the lower part of the leg, on the other hand, correspondingly shortened. Exactly the opposite is seen in the burrowing Insectivora, for example in the moles, in which the fore-limbs undergo the greatest modifications. The fore-foot is greatly increased in breadth and gets turned outwards, and a special subsidiary bone having the form of a bent ploughshare is frequently associated with the strong, flat, closely connected fingers, which are armed with long sharp claws. This powerful delving implement requires also strong muscles to move it, and thus leads to a quite peculiar structure of the bones of the fore-limbs, which are unusually short and broad, and have very pronounced ridges for the attachment of the muscles. In the genera which live in the water the toes are webbed, in all the others there are generally short walking legs with curved claws.

The tail varies greatly in length. In the climbing, leaping, and running forms it is long, sometimes densely covered with hair, sometimes almost quite naked; in others it is short, sometimes altogether absent.

The Insectivora are for the most part very prolific, a fact indicated by the large number of teats, of which there may be as many as five pairs arranged in two rows along the abdomen as far as the chest. The shapeless, naked, large-headed, blind young ones come into the world in a very helpless condition, and generally lie several weeks in the nest before they learn to run. The placenta is discoidal, but shows a very low degree of internal development. The organs of reproduction, especially in the male, agree most closely with those of the rodents.

As the last peculiarity of this group we must mention the large superficial glands occurring in many genera. These diffuse a penetrating musky odour, and are sometimes found at the sides near the middle of the back, as in the shrews, but mostly in the hinder parts of the body near the anus.

The Insectivora are almost all nocturnal animals, and many of them live altogether under the earth in burrows made by themselves. Only the climbers and springers of southern latitudes carry on their hunt by day; the others leave their holes and corners only at sunset, and even hunt under the earth or in the water. They are unsocial, mostly solitary animals, which are found together only in the pairing season. Many of them are so fierce and insatiable that they even attack and consume their own kind. It is asserted that the moles and shrews eat in a single day as much as they themselves weigh; but I am not aware that accurate observations have been made on the subject. Their food consists chiefly of insects, spiders, and so forth; but most of the species do not despise other animal food also, and many attack even much larger and stronger animals with savage fury. Their voracity makes them uncommonly useful to man, to whom they render material assistance in his incessant war against vermin.

Since the dentition is, as we have seen, extraordinarily varied and affords no general marks of distinction, we divide the Insectivora in accordance with their habits.

BANXRINGS OR CLIMBERS.

(TUPAIÆ).

Resembling squirrels, with sharp naked proboscis, and long tufted tail.

This group is composed of several closely allied genera, the dentition of which has a primitive character, inasmuch as incisors, canines, and premolars stand apart from one another and are scarcely different in form and size. The typical genus, Cladobates (Tupaia), has 38 teeth; another, Ptilocercus, has 42 teeth; and the third, Hylomys, as many as 44. These lively and elegant climbers, the largest species of which, the **Tana** or Banxring (*Cladobates Tana*), shown in fig. 46, is somewhat like a squirrel in size and appearance, live in the forests of India and the Sunda Islands. Their soft velvety fur shows gray, brownish, and greenish colours, which closely approach those of the branches and twigs on which they climb, so that they can easily hide themselves. The claws of their five distinct toes are sharp and curved like those of our squirrels. They hunt by day on trees and on the earth for insects and larvæ, and go sniffing all round with their long snout covered with stiff moustache bristles. The eyes are large, and set in a closed orbit; the ears rounded and short. Since they have four abdominal teats, they probably bring forth several young at a birth. Little further is known of their habits, and no living specimens have yet been brought to Europe.[1]

THE JUMPING-SHREWS

(MACROSCELIDA).

Like the jerboas, but with a long snout; natives of Africa.

The disproportion between the hind- and fore-limbs is not quite so great as in the jerboas; the tail is shorter and has no tuft at the end. At a distance, indeed, the little creatures might easily be confounded with jerboas, but when seen close at hand they are at once distinguished by their long and very mobile proboscis, their large ears, which through the development of transverse ribs in the flaps somewhat resemble the ears of certain bats, and by their longer fore- and shorter hind-limbs. The latter are furnished in some species with five, in others with four toes, and have the metatarsal bones very much elongated.

The hotter the sun the more nimbly do these inhabitants of the torrid deserts of Africa jump about, sniffing under stones in all directions with their long proboscis, and even catching insects flying. At the slightest noise they disappear into holes in the earth, or slink away between stones, and since, as in all inhabitants of the desert, the colour of their soft fur is assimilated to that of the soil, they easily escape the eyes of their pursuers.

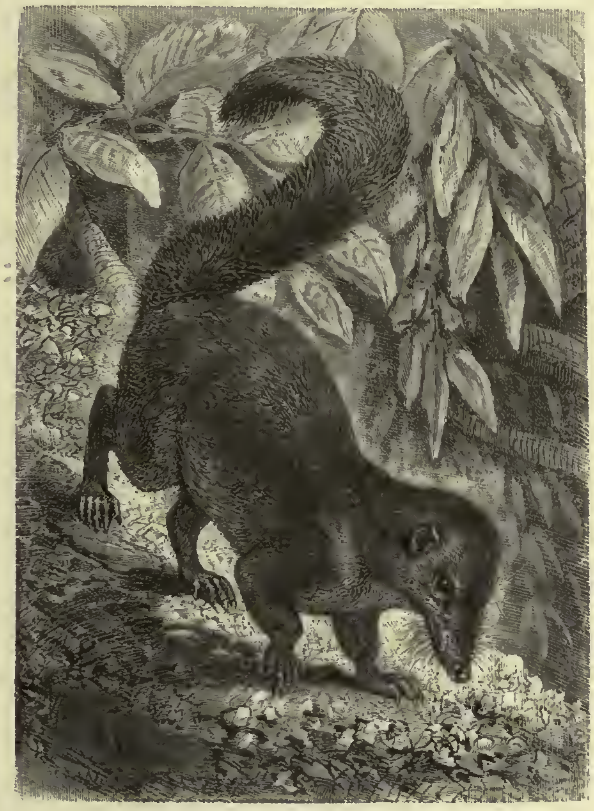


Fig. 46.—The Banxring or Tana (*Cladobates Tana*).

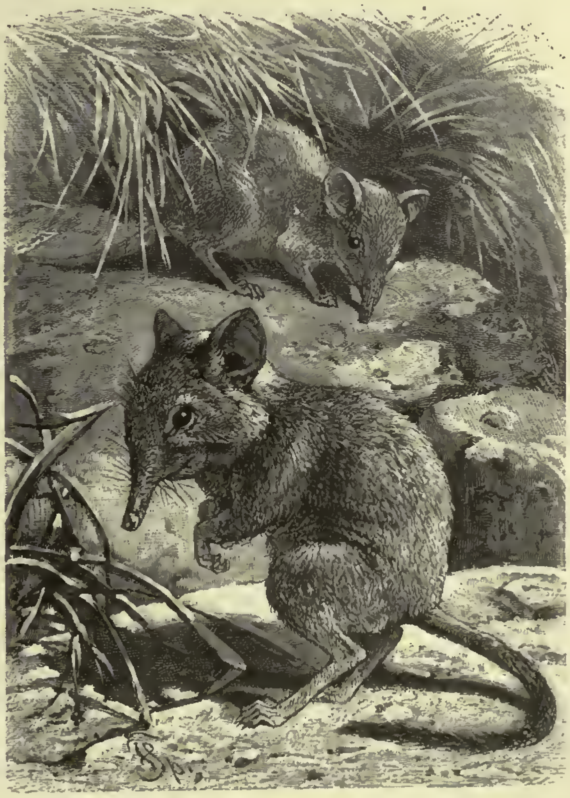


Fig. 47.—The Elephant-shrew (*Macroscelides typicus*). page 116.

---

[1] A specimen was acquired for the Zoological Gardens in London in Jan. 1881.—Tr.

A German name meaning "reed proboscis-bearer" (*Rohrrüssler*) has been invented for these little animals, but the name is altogether inappropriate, since they are never met with among reeds or marshes, but only on the driest ground. The designation "jumping proboscis-bearer" would be more fitting. In the large five-toed species known as the **Elephant-shrew** (*Macroscelides typicus*), which is represented in fig. 47, the body measures rather more than 4 inches, the proboscis less than 1 inch, and the tail is nearly as long as the body. It inhabits South Africa. Another, smaller, species, the **Algerian Jumping-shrew** (*Macroscelides Rozeti*), is found in the north, in Morocco and Algeria. The canine has two roots, and in that respect resembles a premolar in form. A scent-gland at the root of the tail diffuses a strong odour. Occasionally these animals may be seen hunting in pairs, but nothing more is known of their mode of life. Allied genera (Petrodromus) have only four toes on the hind-feet.

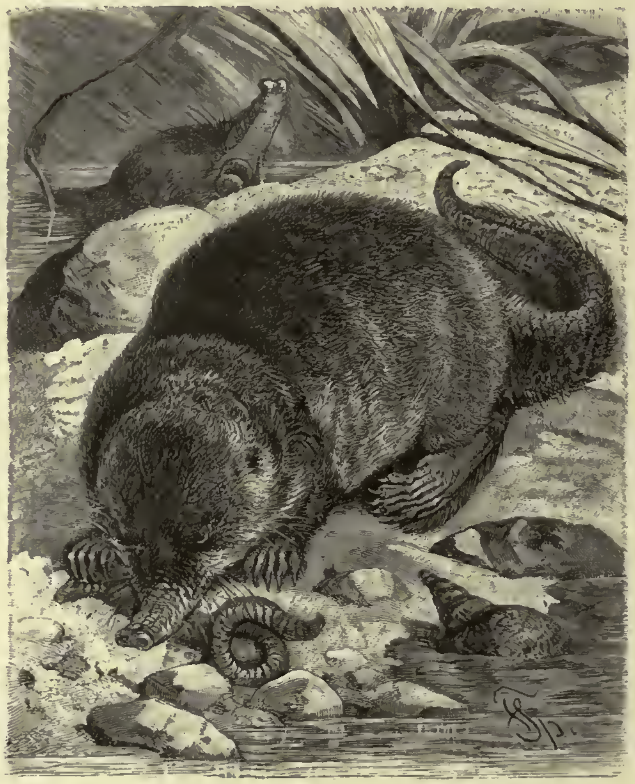


Fig. 48.—The Wuychuchol (*Myogale moschata*).

THE DESMANS OR DIVERS

(MYOGALIDA).

With swimming feet, long proboscis, and flattened tail; a group having a very remarkable geographical distribution.

One species, which forms a genus by itself (Nectogale), is found in Tibet; another genus, Potamogale, with a very peculiar dentition, belongs to West Africa; the typical genus, that of the **Musk-shrews** (Myogale), comprises two species, the larger of which, the **Wuychuchol** (*M. moschata*), is found in the Volga and the other rivers of the steppes of southern Russia, while the smaller species, the **Desman** (*M. pyrenaica*), is found in the torrents of the Pyrenees and other mountain-chains of northern Spain.

The remarkably mobile naked proboscis, notched at the extremity, the feet with five toes all connected by a web, and the long flattened tail covered with scales at the end enable us to recognize these creatures at the first glance. The eyes are very small, and almost completely hidden in the fur; there are no external ears; the hind-feet are very much elongated, curved, and scaly, and have something of the appearance of those of a swan, except that they have five well-formed toes. The web extends to the root of the claw on each toe. The scent-glands under the root of the tail diffuse an intolerable and very persistent musk-odour.

The dentition is very peculiar. In the premaxilla (upper jaw) there is on each side only one large strong incisor, which has a pyramidal form and cutting edges; and in the same jaw this tooth is followed on each side by a very small canine, five premolars, and four molars each with three pointed cusps. The lower jaw has on each side two incisors placed horizontally, and only three molars. There are thus in all 44 teeth: dental formula $\frac{1 \cdot 1 \cdot 5 \cdot 4}{2 \cdot 1 \cdot 5 \cdot 3}$.

The species represented in fig. 48, called by the Russians the wuychuchol, is specially abundant in the Volga. The animal is extremely expert in swimming and diving, seldom leaves the water, and lives on leeches, snails, and insects and their larvæ. Its formidable dentition makes me surmise that it also attacks fish. The soft velvety fur, resembling that of the moles but distinguished by having a number of bristly hairs sparsely scattered amongst it, is used as a trimming for caps. The animal prefers ponds and pools, and slowly running waters, and is generally to be found at those parts where there are loamy or clayey banks, in which it can dig out its subterranean dwelling. This consists of a chamber led up to by an obliquely ascending tunnel, the entrance to which is placed so deep below the surface of the water that it does not get frozen up even in the hardest Russian winters. The passage is carefully smoothed internally, and rises so much that the chamber to which it leads is never submerged even by the highest floods. Since the animal has been accidentally caught in fishing-nets by night as well as by day, in summer as well as in winter, it is probable that it has no particular sleeping time, but like the mole rests in its chamber for some hours after every hunting foray to allow time for digestion. The creature seizes its prey with its snout as with a finger, and then pushes it into its mouth. The stench diffused by the scent-glands under the tail communicates itself even to the flesh of pikes by which a wuychuchol has been devoured, and thus renders it uneatable.

THE SHREWS OR RUNNERS

(SORICIDA).

This typical group is composed of the **Shrews**, the form of whose body is like that of mice, from which, however, they are distinguished even externally by the possession of a sharp proboscis and a mostly short naked tail.

They may justly be called runners, for they run along quickly, and climb like mice, with which also they agree in their nocturnal habits. This unfortunate resemblance is very prejudicial to the little creatures. Men, cats, and owls destroy them without mercy, but they are eaten only by the birds, whose senses are not very acute. Cats bite them dead, but leave them lying, apparently because of their strong musky odour, proceeding from two glands which open at the sides about the middle of the back.

The shrews form a group very rich in genera and species, which are distributed over the whole world except South America, Australia and the islands connected with it.

A conical head, pointed very mobile snout or proboscis with stiff tactile hairs, small eyes, short, scarcely projecting ears, small five-toed feet with sharp claws, and a tail inferior in length to that of mice, and covered only with a few thinly scattered hairs, sometimes even scaly—such are the essential characters of the shrews. The total number of the teeth varies from 28 to 32, but the general character of the dentition remains the same. The teeth are so closely set that they sometimes seem to be fused together. A very large recurved incisor with a heel or process behind takes up the greater part of each half of the premaxilla. Behind this fang there are on each side three, four, or even five teeth mostly similar in form and size. The first of these teeth is generally also to be regarded as an incisor, because it stands in the premaxilla, while those coming after are premolars, after which there follow, for the most part, four three-cusped true molars. The lower incisors are also very large, but are placed horizontally, and are curved upwards at the end. In some the tubercles of the teeth are of a light brownish-red colour, in others perfectly white.

The shrews are cruel animals, even against their own kind, and are never found together except at the pairing season. At other times they live a hermit's life, concealing themselves by day in dark holes, and carrying on their hunt by night, uttering, meanwhile, sharp shrill cries. Their activity lasts through the whole year. They seek for insects, larvæ, worms, and snails even under the snow. When two shrews meet there mostly begins a battle for life or death; the victor at once eats up his antagonist. They are not even afraid of attacking animals much stronger than themselves.

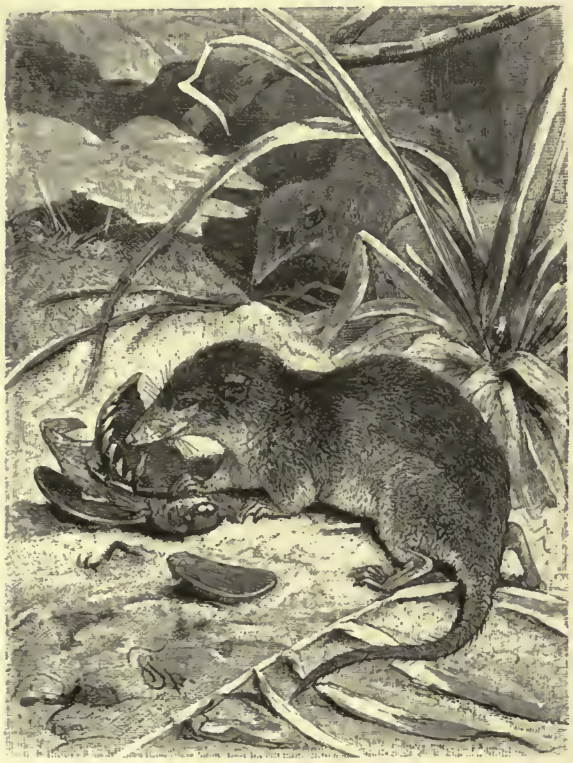


Fig. 49.—The Garden-shrew (*Crocidura aranea*).

The females have mostly four, seldom six abdominal teats, and suckle their blind and shapeless young ones in their secure retreats for a comparatively long time. A regular nest is made for the purpose.

In this group are included the smallest mammals. The body of the shrew of Tuscany (*Sorex etruscus* (*Crocidura etrusca*)) is less than an inch and a half in length, while the tail measures just about one inch.

Illustrations are given of two species which are of peculiar interest on account of their habits.

The **Garden-shrew** (*Crocidura aranea*), fig. 49, has not more than 28 perfectly white teeth, and has a fur like that of a small mouse. Of all species this is the one that comes nearest human dwellings, especially during the winter, being frequently found by day in outhouses, stables, and barns, while by night it pays visits to the kitchen and larder in search of meal-worms, cockroaches. crickets, and other insects. Much evil has been spoken of the little creature, and, if one might believe old wives' fables, the malicious animal gnaws the hoofs of horses, sheep, and swine, makes attacks on the smoked meat in the stoves, and even takes the life of fowls, or at least of chickens, in the most scandalous manner. If these fables were true, it would be impossible to rear any domestic fowls at all, in face of the large numbers of these little creatures which manage to slip in everywhere with ease. I observed for a long time the habits of some shrew-mice which had established themselves among some bundles of wood in an open shed opposite the window of my room. Every evening they gave me warning of the commencement of their hunt by uttering their shrill cries.

If the shrews deserve help and protection on the part of man for the services they render him in destroying vermin, it is different with the large **Water-shrew** (*Crossopus fodiens*), fig. 50, which attains the size of a small rat. Its teeth, 34 in number, have red points. The tail is somewhat flattened, and stiff hairs standing in rows on the edge of the toes appear to take the place of a web.

The ordinary food of the water-shrew consists of insects, worms, water-snails, even of frogs and lizards, and if that were all there would be no great harm done. But there is no doubt that it also attacks fish, and works not a little devastation in ponds and tanks. In winter when the water is covered with ice it will even attack a large carp two pounds in weight, seizing it by the neck, after which it eats out its eyes and brain, getting access to the latter by biting through the skull with its recurved fangs. The more agile fishes, such as the trout, escape from its pursuit.

The following account of the habits of the water-shrew is given in Bell's *British Quadrupeds*:—

"An intimate friend, in whose capabilities for accurate observations we place the greatest reliance, being one day concealed, gun in hand, for the purpose of shooting some carrion crows, near a hill-side ditch at Temple Grafton, near Stratford-on-Avon, had his attention called to a shrew of this species, which was busily engaged in seeking for food amongst the stones in the rapid but shallow water at the bottom of the ditch. These it turned over or displaced, by forcing itself under them, and in this manner several of large size, compared with that of the animal itself, were removed. The food appeared to be taken at the moment the stone was raised from its resting-place, though in some instances by the animal merely poking its long snout under the stone, without lifting it; but in every case, when caught, it was conveyed to the side to be devoured. It consisted of small creatures having hard parts, which the shrew was heard crunching up in the process of mastication.

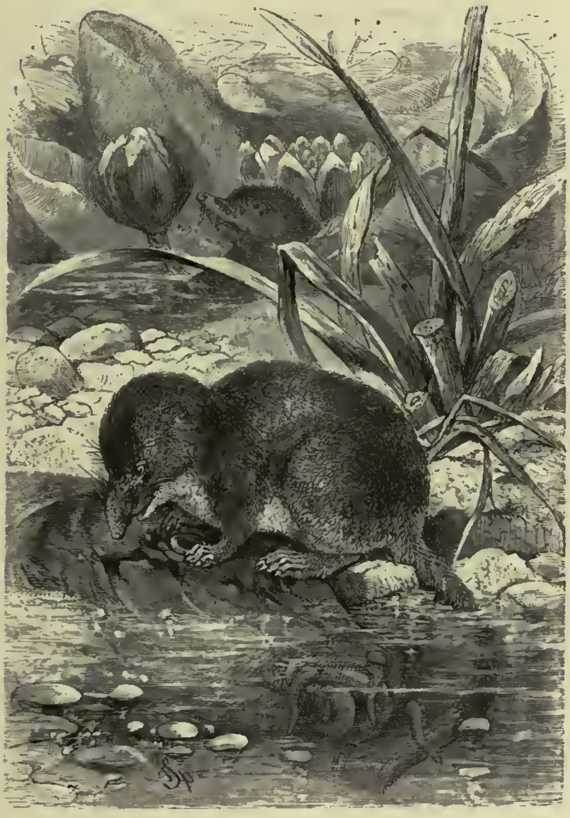


Fig. 50.—The Water-shrew (*Crossopus fodiens*).

"Shortly afterwards the spot was pointed out to us, and, on examination, we found the pretty stream Sessile-eyed Crustacean, *Gammarus Pulex*, in plenty under the stones in the ditch, and entertained but little doubt that it was on these small crustaceans that the shrew was feeding, and that the crushing sound observed during mastication was occasioned by their hard coverings.

"We do not know whether the water-shrew is piscivorous in its habits, though it is not unlikely that it may feed on the spawn or fry of minnows, or other small fish, but to its carnivorous propensities we can ourselves bear testimony. Having occasion to enter an outhouse used as a carpenter's shop at Welford Hill, we were somewhat surprised to hear the shrill chattering squeak of a shrew, and its quick rustle, or rather rush, amongst the shavings upon the floor. Remaining still for a few minutes we saw an animal of the present species emerge from the shavings, and, scampering across a large sheet of brown paper, pass under the dried body of a barn-door fowl which was lying in a corner. On lifting up the fowl by the legs, the shrew made its escape from a hole in the abdomen, and it was found on examination that nearly all the internal parts, in a half-dried and half-decomposed state, had been devoured, though whether wholly by the shrew or partly by mice we are unable to state.

"Another equally well authenticated and interesting notice of its flesh-consuming habits may with advantage be introduced here. A brother of one of the authors of the present work, having one night placed a steel trap for vermin, visited it in the following morning; and on drawing near, saw that it contained a full-grown rat, on which was perched a small black object, which proved on closer approach to be a water-shrew. The rat was dead and the shrew was devouring it. . . .

"We have once, and once only, seen it at Selborne. It was hunting in the most active and curious manner at the bottom of a small roadside stream; and as its body was much flattened, the white of the belly projected in a narrow border, edging the deep black of the back, and rendering it altogether the prettiest object imaginable.

"Its swimming is principally effected by the alternate action of the hinder feet, which produces an unequal or wriggling motion: it makes its way, however, with great velocity, and as it swims rather superficially, with the belly flattened, the sides, as it were, spread out, and the tail extended backwards as a rudder, it forms a very beautiful and pleasing object, moving on the calm surface of a quiet brook, or diving in an instant after its food, its black velvety coat becoming beautifully silvered with the innumerable bubbles of air that cover it when submerged; and on rising again, the fur is observed to be perfectly dry, repelling the water as completely as the feathers of the water-fowl. When submerged, the ear is nearly closed by means of three little valves."

We annex to the group of the Runners a few foreign genera, which might in part be formed into separate families, but which are only imperfectly known. An illustration is furnished of one species which belongs exclusively to the Antilles—the **Agouta** or Almiqui of the natives (*Solenodon paradoxum*), fig. 51. It is one of the largest of the Insectivora, and possesses the large upper triangular incisor of the musk-shrews, and in the lower jaw has the second incisor in the form of a canine. The teeth, 40 in number, are white, and their form approaches that of the tanrec of Madagascar. The proboscis-like snout is very long, pointed, and mobile, the tail round and scaly, the toes armed with sharp claws, the body about 8 inches in length. Nothing is known of the habits of these creatures. Judging from their teeth we must suppose that they live solely on animal food. They form along with some African genera (Potamogale, Rhynchocyon, Eupleres) remarkable connecting links between the large groups of the shrews, the tanrecs, and the hedgehogs, and even with the Viverrida among the Carnivora.

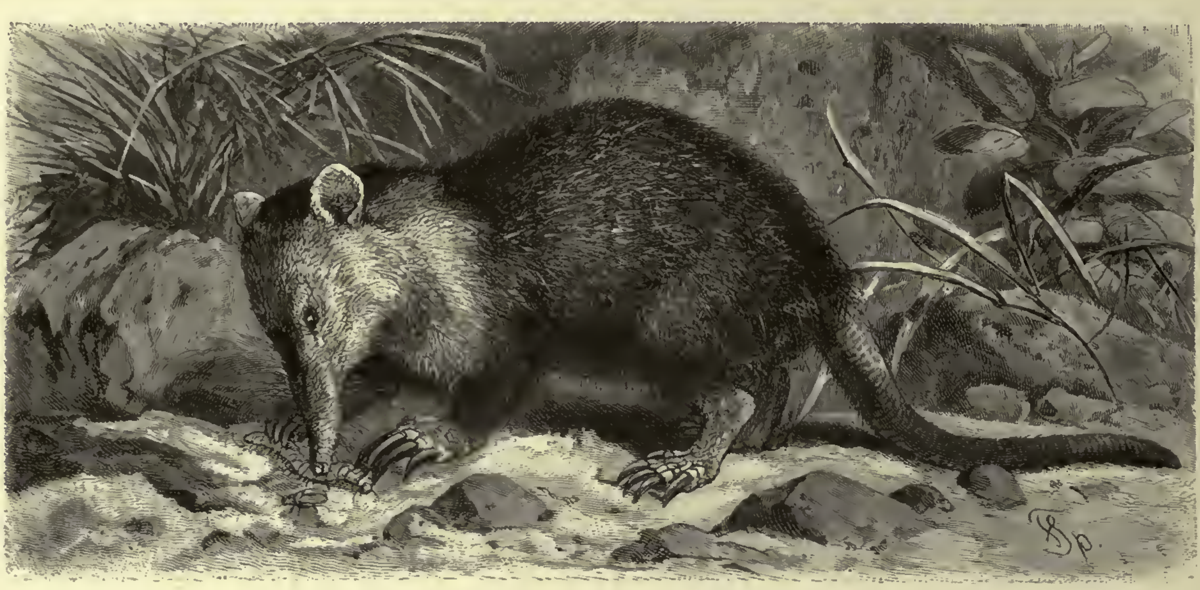


Fig. 51.—The Agouta or Almiqui (*Solenodon paradoxum*).

THE CRAWLERS.

The Tanrecs (*Centetida*).

Natives of the island of Madagascar which have the appearance of our hedgehogs.

This is a very isolated group as regards its geographical distribution and structural organization, and is made up of several genera distinguished by their dentition and the character of their fur, but agreeing with the shrews in the absence of the zygomatic arch, with the hedgehogs in the absence of a pubic symphysis, and with the members of the genus Cladobates in having the bones of the lower leg, the tibia and fibula, which in all other Insectivora are more or less fused together, perfectly distinct.

The dentition is rather variable. The true **Tanrecs** (forming the genus Centetes), fig. 52, have 40 teeth; others, to which the name of **Tendracs** (forming the genus Ericulus) has been given, have only 36. The carnivorous nature of these animals is indicated in the former by the recurved canines in both jaws and the development of crests on the rather long skull, while in the tendracs the canine is no way different from the following premolars. Some species are all prickly like our hedgehogs, others have only scattered spines mingled with coarse hair, and others again have a very soft fur without any trace of spines. The snout is always much more pointed than in our hedgehogs, and the tail is usually wanting or is represented only by a short stump. All the species are capable of rolling themselves up like a ball, but this power is much less developed in those forms which have a slender body and a semi-spinous coat, than in those which are better protected by their spines.

Have the tanrecs been introduced by man into the islands of Mauritius and Bourbon? So it is said; but that is not quite certain. In any case they are now completely naturalized in both, and live there in the same way as on the great African island, that is to say, squeezing themselves by day into some hole or corner, and by night hunting after their food, which consists mainly of insects, spiders, millipedes, and the like, to which, however, they are fond of adding small vertebrates or fruits. The natives eat them, but prefer the females, since the males diffuse a strong musky odour which taints their flesh. Some authors maintain that they have a summer-sleep, like the winter-sleep of our hedgehogs, but by others this is denied. Of the genus Gymnura we are acquainted with only one species (*G. Rafflesii*), which is a native of Sumatra, and is characterized by the absence of spines, the great length of the body, the almost naked tail, and the large number of its teeth (44 in all).

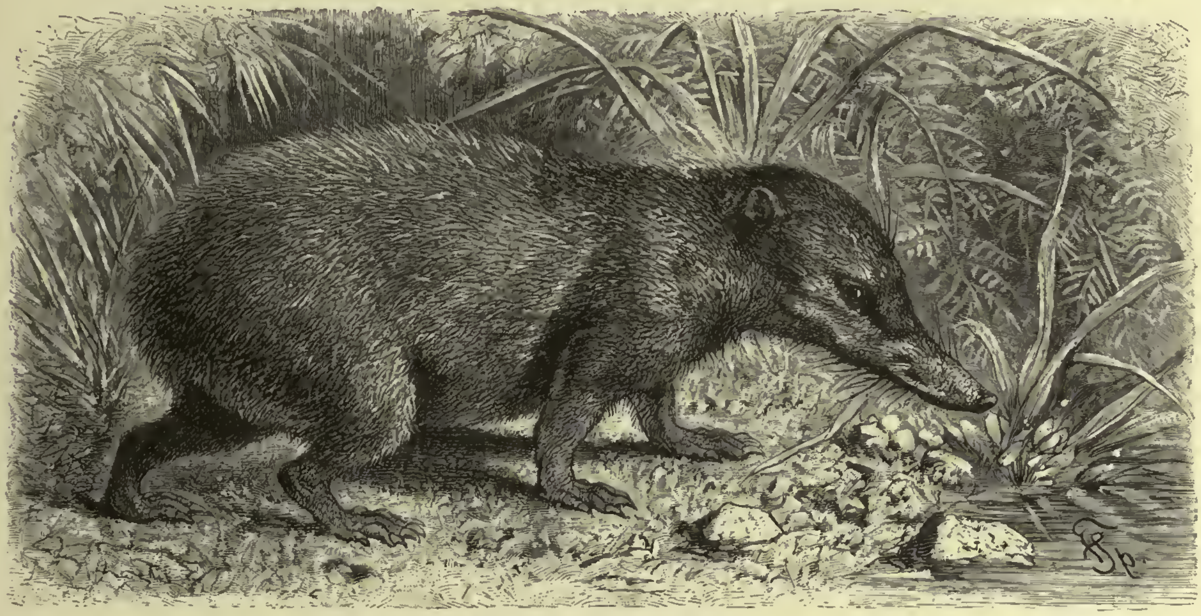


Fig. 52.—The Tanrec (*Centetes ecaudatus*).

The Hedgehogs (*Erinacei*).

A group composed of the completely spiny inhabitants of the continents of the Old World.

Except for the abnormal genus Gymnura the hedgehogs form a tolerably uniform group, with sufficiently well-marked characters, and found only on the mainland.

In the hedgehogs proper the head is short, the snout pointed, but not elongated, the body compact, and covered on the whole of the upper surface with short, thick, pointed spines, which the animal can erect in rolling itself into a ball; the five-toed paws with short claws are not very long; the tail is short or absent.

The dentition appears to indicate a mixed diet. There are no prominent canines; on the crowns of the molars there are conical cusps which soon get worn away; the canines and premolars are not very different in structure, but the first incisor in the upper jaw is strong and vertical, and can play the part of a canine.

Our **Hedgehog** (*Erinaceus europæus*), fig. 53, belongs to the type genus. Many fables have been invented regarding this peaceable and timid creature, which sleeps by day rolled up like a ball under bushes or hedges, and roams about by night seeking its food, which is beyond question of the most varied description. Insects and their larvæ make up the chief part of it; but eggs, and the small birds which make their nests on the ground, frogs and reptiles, as well as mice, are greedily devoured, and fruits that may have fallen to the ground or which it can reach by climbing form an agreeable dessert. The movements of the hedgehog are sluggish, their steps almost tottering, their gait clumsy but noiseless; yet, in spite of this apparent clumsiness and helplessness, the hedgehog is perhaps even better fitted for hunting mice than the cat. It patiently lies in wait for the nimble rodent at the entrance of its hole, and even shows some skill in reaching its prey by burrowing. The noise which it makes in barns, cellars, and stables perhaps helps to drive away the mice; so much, at least, is certain, that places visited by hedgehogs are soon freed from rats and mice and all their kindred.

But what makes the hedgehog invaluable is its power of withstanding organic poisons. It eats up the cantharides insects, from which are made the well-known blistering applications, with as much satisfaction as the may-bug, and wages an always successful war against poisonous snakes. This insusceptibility to the action of organic poisons has been confirmed by repeated experiments. The hedgehog does not suffer in the least from the bite of a viper which could kill a dog. It is well aware, however, of the dangerous nature of its opponent, for it always begins by crushing a viper's head, while it attacks non-poisonous snakes at any part.

Although in such battles the hedgehog gives proofs of courage, yet it shows great timidity in its behaviour otherwise. On the least noise it rolls itself up into a ball, and exposes its erect spines to its antagonist. Dogs attack it with fury, but they require a special training to learn how to seize it. The fox, it is said, resorts to disgusting methods to compel it to unrol itself. In spite of its strong smell it is eaten in some parts, but the less strongly smelling females are preferred to the males.

The female brings forth from four to seven young ones at a time, and even at birth soft spines adhere to the skin by means of a slimy secretion. The mother tends her young with much affection till they are able to supply their own wants. In fig. 53 is represented one of these happy families, which has established itself in a comfortable nest at the foot of a hedge. In the fables the hedgehog plays the part of the shrewd fellow, who beats the hare at running, drives the fox out of his hole, and always manages to get the better of his opponents, whether alone or with the assistance of his wife, who is just like himself, and with whom he lives on the best understanding. In this respect he forms, it must be admitted, an exception among the Insectivora, for the pairs remain united the whole year through.

It is well known that in northern countries the hedgehog passes the winter sleeping. It usually makes a warm nest for itself beneath a hedge, lines it with dry leaves, and rolled up within, it there awaits the return of the spring. Its sleep is not very deep, however, and on warm days in winter it is often to be seen crawling about in search of food.

THE BURROWERS.

A group in which the fore-feet are transformed into strong spades.

In the members of this group the head is always conical and pointed, and often ends in a prolongation which serves as a proboscis. The cylindrical often very compact body is broader in front in consequence of the enormous development of the region of the shoulders, and in consequence of the fact that the fore-limbs are almost hidden in the fur. These limbs end in two short but broad spade-like paws, and are armed with long, flat claws with cutting edges. The hinder part of the body is weak, the tail is sometimes rudimentary or quite absent, sometimes long; the eyes either very small and hidden among the hair, or even quite covered over by the skin. External ears are altogether wanting. All burrowers lead an essentially subterranean life, and seldom come to the surface. Living almost entirely on animal food they hunt after subterranean vermin, of which they destroy great quantities. In pursuing their prey they tunnel their way through the earth with great rapidity. They are all extraordinarily voracious, indeed insatiable. Cruel and savage, they live a hermit's life in their chambers, the males seeking the females only during the pairing season. Usually a male can secure a female for itself only after engaging in violent battles with rivals.

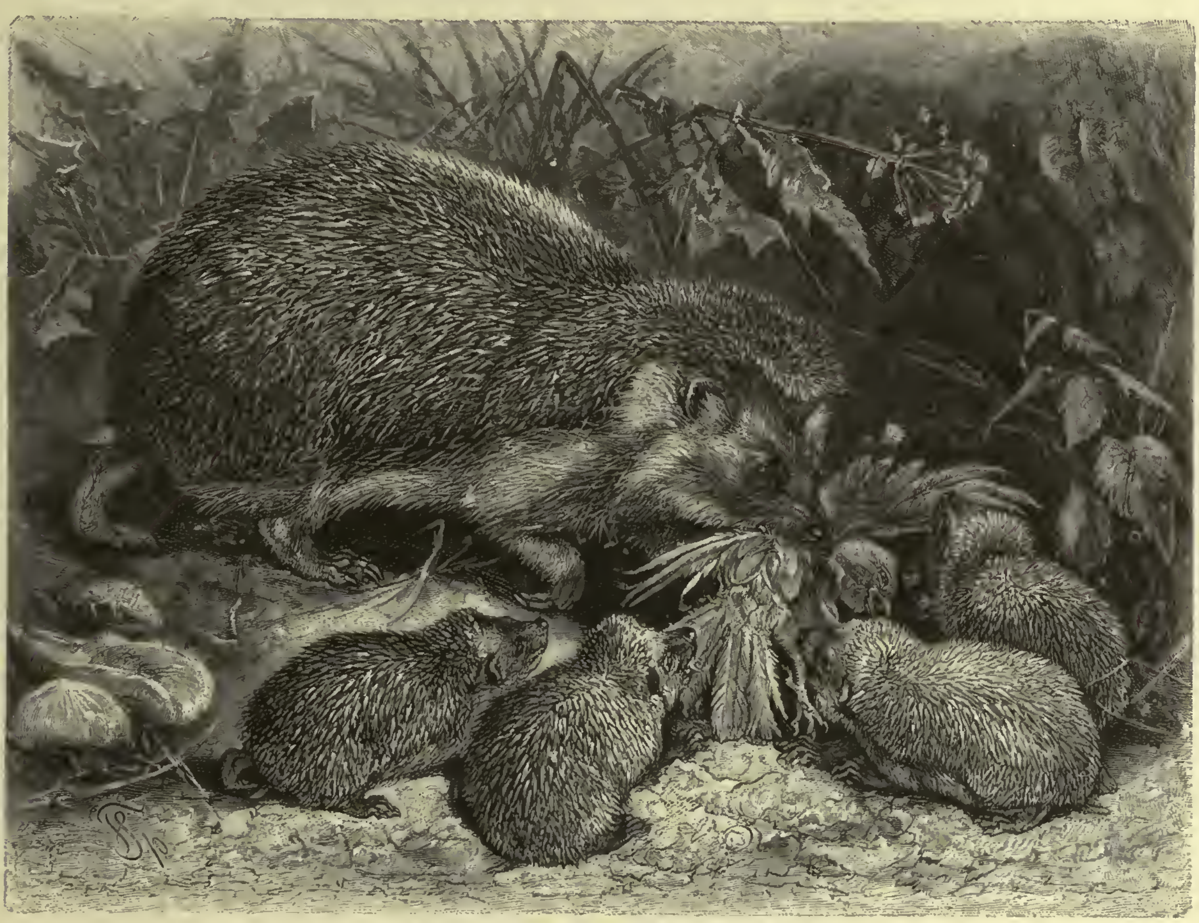


Fig. 53.—A Family of Hedgehogs (*Erinaceus europæus*).

The Moles (*Talpidæ*).

With five toes on the fore-paws.

Our common mole (*Talpa europæa*), fig. 54, may be taken as the type of this group, so rich in genera and species.

Who has not seen it hanging from a trap, with its sausage-shaped body, its sharp conical head, its snout supported by an internal cartilaginous rod, its broad naked fore-paws turned outwards and armed with short broad sickle-shaped claws, with which a sabre-shaped ploughshare bone is combined in order to make the whole spade as broad as possible?

LIBRARY THE UNIVERSITY OF CALIFORNIA

The small eyes gleaming like carbuncles can only be seen after the hair in which they are buried has been blown aside. The external ears are absent, and the entrance to the auditory passage is protected by stiff hairs. The hind-paws are weak, straight, five-toed; the tail is short; the dentition is allied to that of the carnivores; it consists in all of 44 teeth; three incisors above, four below, which are followed by a strong canine with two roots. The upper canine is particularly sharp, and is pointed and recurved. The single-cusped premolars pass gradually into molars provided with several sharp pointed cusps. The mole lives solitary in its dark chamber, from which as a centre it untiringly digs out winding passages the whole year round, even under the snow. The fortress is constructed at a suitable depth at some distance from the hunting-ground, mostly under the roots of a thick tree, and is connected by a main gallery with the hunting-passages. This fortress is a perfect work of art in its way. Two circular galleries, having numerous connections with each other and with the parts beyond, surround a bottle-shaped chamber, which is made warm with the stems of grass and with dry mosses. The hunting-passages are carried to great distances, and are indicated in places by the heaps of earth thrown up, the well-known molehills. The mole extends these passages two or three times a day in search for prey, and afterwards retires to its fortress. At the breeding season the male shuts up the female, whom he has acquired by force, in a nest situated at some little distance from his fortress, and there she brings into the world from four to eight blind young ones, which she is often compelled to defend against the male.

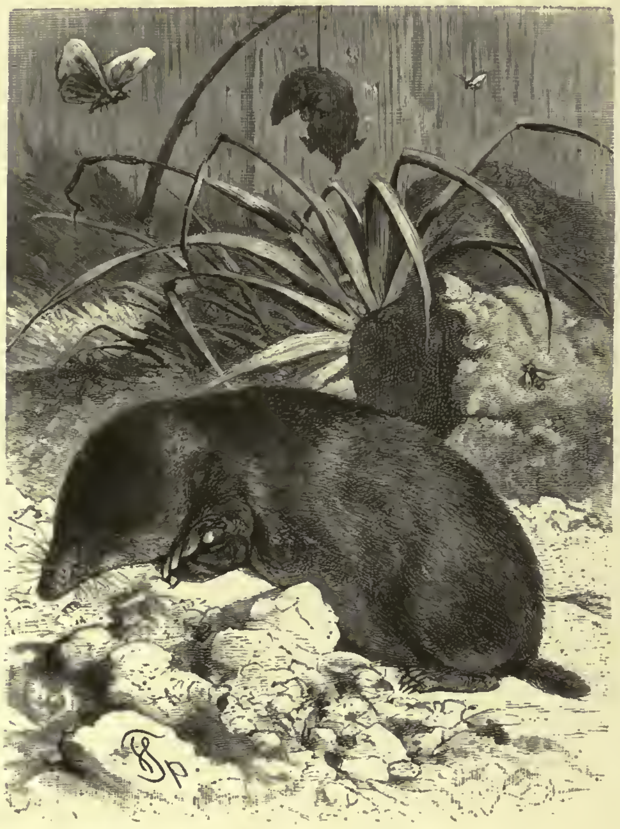


Fig. 54.—The Common Mole (*Talpa europæa*). page 123.

That the character which seems to be indicated by this last fact is not universally applicable to the mole there is good reason to think. "It would appear that the affection of the male for his mate continues to be of a very warm kind, at least M. Le Court states that he several times found a female caught in a trap with the male lying dead beside her. The possession of strong family affections by the mole would seem further to be proved by an observation communicated to M. Le Court, according to which, when the mole's nest is invaded by a sudden flood, both parents may be seen struggling bravely, and risking their own lives to save their young, and mutually assisting and protecting each other while thus engaged."—W. S. Dallas in Cassell's *Nat. Hist., order Insectivora.*

Nevertheless it must be admitted that other accounts show that the instances just quoted are quite compatible with the occasional manifestation of an extraordinary ferocity of disposition such as that indicated in the text. When urged by hunger the mole would seem to be capable of almost anything to allay its pangs, of the fierceness of which M. Geoffroy St. Hilaire speaks in remarkably energetic terms. "The mole," he says, "does not suffer from hunger like all other animals. In it this appetite is heightened. It is an exhaustion felt even to frenzy. The animal exhibits a violent agitation; it is animated with fury when it darts on its prey; its gluttony disorders all its faculties; nothing is allowed to stand in the way in its efforts to assuage its hunger; it abandons itself to its voracity, whatever may happen; neither the presence of man, nor obstacles, nor menaces deter or stop it." In the *Dict. Classique d'Hist. Naturelle* it is added that "a mole dies of hunger in a very short time, and it is a noteworthy fact that even when its hunger is carried to the highest pitch it never touches vegetable substances that may be lying beside it. On the contrary, let an animal be within its reach, and it will suddenly dart upon it, rip open its belly, and devour it almost entirely in a brief space of time. Toads are almost the only animals which are distasteful to it; frogs and birds it devours with avidity. If two moles of the same sex are inclosed together the weaker is soon devoured, and only the skin and some bones belonging to it will be left."

It cannot be too often repeated that the mole lives exclusively on animal food, that it never touches either roots or any other kind of vegetable matter, that it feeds on all sorts of underground vermin (worms and maggots), that it also eats snails and even frogs, which it is very clever in seizing, darting forth from the earth with the rapidity of an arrow, and that it will rather die of hunger than eat any kind of tuber or other juicy root.

He is thus in consequence of his mode of feeding himself a useful animal, which frees us from all kinds of subterranean vermin, and one does wrong, great wrong, in persecuting him in places where the throwing up of molehills can do no harm. No doubt where plantations might be damaged the injury that may be wrought by the making of the underground passages and the throwing up of the molehills must be placed against the benefits which the mole confers as a destroyer of vermin, but should not lead to his being blindly extirpated.

Partly in consequence of differences in the dentition, partly in consequence of peculiarities in structure, a number of genera in this group have been separated off from the true moles. We have figured as the type of these foreigners a Canadian form, the **Star-nosed Mole** (*Condylura cristata*), fig. 55, whose snout ends in a star-shaped plate of cartilage, which has the nostrils in the middle. The long tail is thickly covered with hair, the fore-limbs are much longer than in our moles. The dentition is also different. The first incisor presents a form which indicates some approach to that of the musk-shrew. This form is still more developed in another mole from the same region (*Scalops canadensis*), which forms a connecting link with the next group through its dentition and its short, compact form of body.

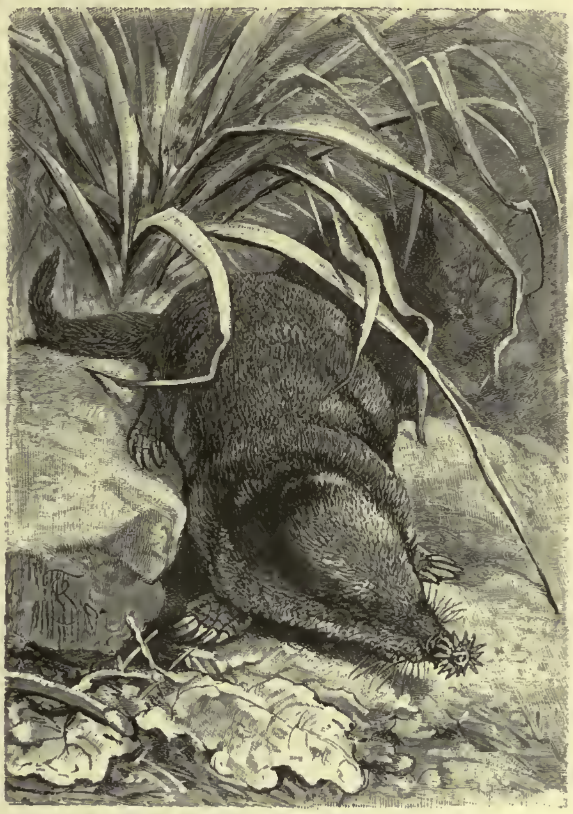


Fig. 55.—The Star-nosed Mole (*Condylura cristata*).

Group of the Golden Moles (*Chrysochlorida*).

Forms belonging to the Cape, with three-toed fore-limbs and fur with rainbow reflex colours.

These are small animals with short, cylindrical body, extremely short limbs, and no tail. The structure of the skeleton of the fore-limb stands quite alone in the animal world on account of the peculiar form of the wrist bones. The three toes of the fore-paw carry enormous sickle-shaped claws like those of the ant-eaters. The dentition approaches very close to that of the musk-shrews, and comprises in all 40 teeth. The first incisor is pyramidal in shape and sharp, and takes the place of a true canine, which is wanting.

The fur, which is soft and velvety like that of all burrowers, presents in the reflex shimmer of rainbow colours an appearance which we are not accustomed to see in mammals. The golden moles have pretty much the same habits as the true moles. Little further, however, is known about them. Fig. 56 shows a drawing of the commonest species.

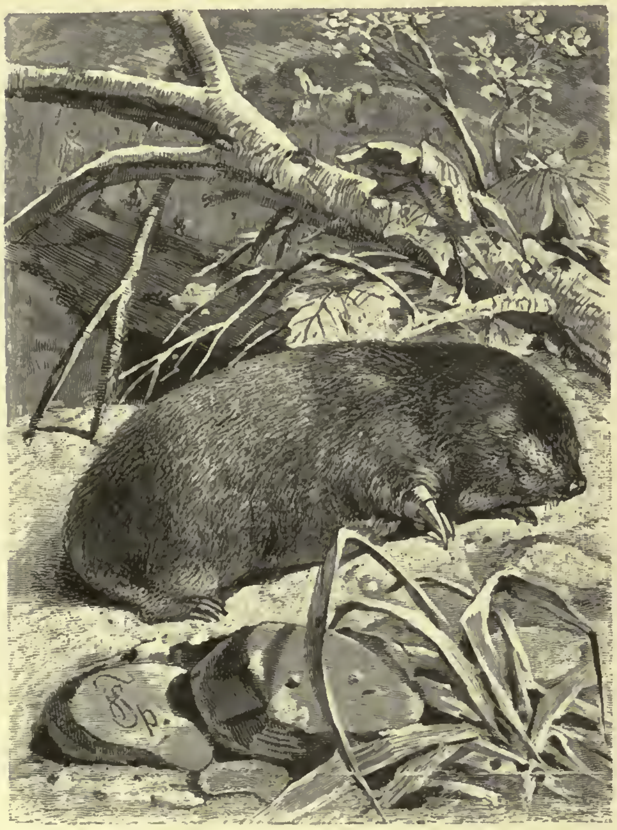


Fig. 56.—The Cape Golden Mole (*Chrysochloris capensis*).

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE INSECT-EATERS.

This subject presents several points of interest. What first strikes one is the fact that the group is altogether unrepresented on the mainland of South America, as well as in Australia and the Australasian islands generally.

This absence of the Insectivora in the two large areas just mentioned can be ascribed neither to the climate nor to the want of suitable food. We find Insectivora in the warmest districts of the earth, and there is probably no other part of the world so rich in insects as South America. The cause of this remarkable deficiency in these regions must accordingly be sought for in the origin of the Insectivora, of which we shall speak later on.

The deficiency is all the more striking since Cuba and Hayti, these two large islands of the Antilles which lie under the tropics, are inhabited by the peculiar genus Solenodon, which, as we have seen, is sufficiently specialized to form the type of a separate family. There are likewise other examples of similarly restricted distribution.

The island of Madagascar has its peculiar insectivores. The tanrecs are found only there and on the neighbouring islands of Mauritius and Bourbon, which perhaps were formerly connected by land with the larger island. The genus Eupleres, so remarkable on account of its affinity to the Viverrida, has been found solely in Madagascar. This island thus forms, as regards the Insectivora, a quite isolated zoological province, which seems to have no relation either to the African mainland or to any other part of the world.

The mainland of Africa possesses as peculiar types the jumpers in the deserts of the North and South, the golden moles, which at the Cape take the place of the true moles, and an inhabitant of the water, Potamogale, which has been discovered in the Gaboon and in Angola, a creature which leads a life like that of a fish-otter, feeding chiefly on fish and crustaceans, and which must be taken as forming the type of a separate family.

The East Indies, including the Sunda Islands, possess exclusively the climbing tupaias, as well as the genus Gymnura, a genus considerably different from the true hedgehogs, with which it is perhaps improperly associated.

The hedgehogs are entirely absent from the mainland of America as well as from the greater part of Africa. In Africa they are found only in the extreme south and in the regions bordering on the Mediterranean, which possess so many other animals in common with Europe. On the other hand, this group inhabits the whole of Europe and Asia as far as the temperate parts of the Western Himalayas.

Africa has no true moles, these being confined to the north temperate zones of the two hemispheres, and advancing in Asia only as far as the Himalayas. The American genera (Condylura, Scalops) are distinguished by so important peculiarities, that many naturalists have separated them from the moles proper in order to make them types of special families, in spite of the similarity in the structure of the fore-paws.

The shrews alone are spread over the whole of the vast area occupied by the insectivores, from the polar regions to the tropics, and from the snow-clad mountains to the plains. They accordingly present strange developments in order to adapt them to all the conditions of life which our globe has to offer. In face of this wide distribution in all directions the fact already mentioned of the exclusion of the insectivores from South America and from Australia acquires increased importance.

Our surprise is still further heightened, when we see certain nearly allied species belonging to one and the same genus separated by wide intervals of land. Of the two species of the true musk-shrews one frequents, as we have seen, the torrents of the Pyrenees and Northern Spain, the other the rivers of the Russian steppes. The two species of Macroscelides, or jumping-shrews, one of which is a native of the Cape, and the other of North Africa, are separated by the greater part of the huge extent of the African continent; and the allied genus Petrodromus likewise inhabits an isolated district in Mozambique.

All these striking facts we may, not perhaps exactly explain, but at least partially elucidate by a consideration of the origin or descent of the Insectivora. Our Insectivora are the descendants of very old stocks, which can be traced back to the oldest strata in which have been found any remains of mammals at all.

It is, in fact, the upper strata of the Keuper (belonging to the Triassic system) in Europe and North America, in which have been found jaws and teeth of the oldest mammals yet known. These remains, which have been ascribed to genera called respectively Dromotherium and Microlestes, exhibit a dentition like that of the Insectivora. Are they the remains of genuine Insectivora, of insect-eating marsupials, or, as a distinguished American naturalist, Mr. Marsh, maintains, of the predecessors of the marsupials?

It is difficult to decide. The large number of the teeth in the single lower jaw that is known, and the distance of the teeth from each other, are in favour of the marsupial character of the remains; but the absence of the inflexed angle of the hinder part of the lower jaw, which is characteristic in the Marsupialia, induces us to decide in favour of Mr. Marsh. Whichever view one adheres to, so much at least is certain, that the insectivorous type of dentition in these oldest mammals is something that cannot be questioned, and this structure is also seen in some other jaws that have been found in the Purbeck limestones of the upper Jura, remains from which Owen has formed the genera Spalacotherium, Triconodon, and others, which he at first assigned to the insect-eaters, afterwards to the marsupials.

Now it has not escaped the notice of anyone that these fossil remains, as well as several other similar remains which have been found in the Stonesfield slates belonging to the lower Oolite formation, present the greatest analogy to certain insect-eating marsupials of the present day, which again show so much resemblance to the present placental Insectivora, that several genera of this latter group were regarded as marsupials as long as their organs of reproduction remained unknown to naturalists.

Since the dentition is a remarkably conservative element in the structure of mammals, it may be inferred from all these circumstances that our present-day insectivores are the descendants of older marsupial stocks, which have been continued uninterruptedly through the various geological periods, but in which the reproductive organs have undergone progressive modifications, while the other organs have remained more or less backward in development.

The fossil remains of Insectivora are rare, which is easily explained by the small size and the rapid weathering of the bones. Undoubted remains of Insectivora have, nevertheless, been found in the Eocene of Wyoming (North America), and in the phosphorites of Quercy in France belonging to the upper Eocene, remains, however, which cannot be ranked without some violence in any of the families now living. It is not till we reach the Miocene that the remains exhibit the characters of the families of the present day—hedgehogs, moles, and shrews.

Now we understand partially the very singular geographical distribution above indicated. In Australia mammals have not developed beyond the primitive marsupial type. Insect-eating marsupials but no true insectivores are to be found there. A singular phenomenon is met with in South America. There we find a number of placental mammals, but the insect-eating marsupials have perpetuated themselves as opossums without further development in this formerly isolated continent.

Madagascar, separated from the mainland as it has been since the Eocene period, and the Antilles, which have not been connected with the mainland since the Miocene, have their own insectivores, derived from peculiar marsupial stocks. North America has only the shrews in common with the Old World, and these perhaps have immigrated from the north, while all the other types of this continent appear to have developed from independent stocks. Analogous facts are observed in Africa, the East Indies, and the temperate zone of the great Eurasian continent. The separation of closely allied species by wide intervals of land is perhaps explicable on the supposition that allied forms have died out in the intervening tracts. Of the wuychuchol it is at least definitely known that it existed in England in the Quaternary period, so that accordingly the genus Myogale was at that time probably spread over the whole of Europe.

The rarity and inadequacy of the fossil remains certainly leave great gaps in the derivation of the separate types now living. Of many of them we are still unacquainted with the intermediate forms.

From the facts that have been already adduced it has been established with perfect clearness that the Insectivora cannot have originated from any one stock, but that separate stocks already existed in Triassic times.

The bats are flying insectivores, but we cannot trace their ancestors further back than the Eocene, when they already appear with their characteristic wings. It is possible that the ouistitis among the American monkeys, and certain genera of lemurs with an insectivorous dentition, are descendants of marsupials, which, under the influence of special conditions of life, have developed to that point at which they have come to approach those lemurs which seem to be descended from ancient hoofed animals (Ungulata). But we know nothing definite with regard to this, and it is better to recognize the gaps in our knowledge, than to fill them up with more or less arbitrary conjectures.

THE FLESH-EATERS

(CARNIVORA).

Mammals with zonary placenta, free clawed toes, well developed canines, and more or less cutting molars.

Numerous variations on a simple and strictly limited theme! The Carnivora form in fact one of the best defined orders in the class of the Mammalia. The internal organization, taken as a whole, is the same in all, while the bodily form, the dentition, the fur, the structure of the limbs are subject indeed to considerable variations, but the deviations from a common type under all these heads are neither so wide nor so numerous as those we have met with among the Insectivora. In spite of all the variety there prevails within this order a certain harmony, in so far as very eccentric forms do not occur at all. A tabular statement relating to the order, drawn up on the model of police returns, would contain under almost all the headings the word "Average."

Among the Carnivora we meet with all gradations, from the powerful and even clumsy types to the rather slender small forms; but we find neither giants nor dwarfs as in other orders. From the lion to the weasel there is certainly abundant room for a variety of forms.

The head, which is always well marked off from the neck, is mostly roundish, but frequently also drawn out into a rather long muzzle. Its middle part is usually pretty broad in consequence of the considerable development of the muscles of mastication, which set the formidable jaws in motion. In general the head in those forms which live solely on animal food may be rounder, the muzzle broader, while in those genera which add to their diet a little vegetable food, the head is apt to become narrower and the muzzle more pointed. The ears are always sharp and mobile; the eyes pretty large, and, though situated at the side of the head, directed forwards, their pupils sometimes roundish, sometimes in the form of vertical slits. The frequently pointed or at least elongated muzzle never forms a proboscis, such as occurs so often among the Insectivora. The opening of the jaws is wide and is surrounded by fleshy lips, on which there are often set very long tactile hairs.

The body is sometimes compact or even thickset, sometimes rather long; the limbs in general of medium length, and though somewhat shortened in those species which creep or swim, never very short or very long, and in any case always fleshy down to the ankle-bones. There is never any remarkable disproportion between the fore- and hind-limbs, as in all jumping animals. The upper parts of the limbs are not free from the trunk as in the monkeys and the bats. There is always a tail, but this organ is developed in very variable proportions.

The structure of the whole body, and

especially that of the skeleton, in most cases combines great power of movement with great strength. The ridges for the attachment of the muscles are always very prominent. The bony substance is very dense, thus affording the greatest power of resistance with the least bulk.

The brain-case, which is in itself small, appears larger during life in consequence of the remarkable development of the ridges to which the muscles of the jaws and the nape of the neck are attached. In the great majority of beasts of prey there is a well-marked longitudinal ridge on the middle line of the skull, the sagittal crest, which is continued behind into two lateral ridges surrounding the back part of the skull. The wide sweep of the zygomatic arch, which attains its highest development in the cat tribe (the Felida), also points to the extraordinary development of the muscles of mastication. The orbits are never closed, but are always continuous with the temporal fossæ or depressions at the temples. At the base of the large zygomatic arches are the cavities which receive the hinder joints of the lower jaw. The cavities in question form transverse pits, in which the rounded ends of the bones of the lower jaw can turn round their axis. This arrangement does not permit of any lateral movement of the lower jaw, which can only be raised and depressed. The carnivore can thus never grind his food by the process of mastication. The movements by which this is effected, as by the ruminants, are altogether out of his power. The halves of the lower jaw never become fused together, but are always separated by a suture in front.

The chest is always flattened at the sides, so that the breast-bone often forms a pretty prominent keel. The shoulder-girdle consists only of a shoulder-blade. The collarbone is altogether wanting or quite rudimentary. This structure would in itself show that the fore-limb is not adapted for the performance of complicated functions, that it cannot be a true prehensile organ or organ of flight. In harmony with this structure the power of rotating the bones of the forearm about themselves, what is called in scientific language the power of pronation and supination, is extremely limited.

The carnivore can run, strike with his paw, can knock down his prey and hold it fast, but he can only in exceptional cases make use of his paw to carry his food to his mouth.

We reserve till further on the thorough examination of the feet and teeth; and as to the brain, all that we wish to observe here is that the large brain, or cerebrum, which always exhibits distinct convolutions, never covers the small brain or cerebellum, and always displays a peculiar structure in the disposition of the fissures and convolutions, a structure entirely different from that of the apes and monkeys. The stomach is always simple, sack-shaped. The intestine, very short in the pure flesh-eaters, becomes a little longer in those species which adopt a mixed diet. All the species have an unpleasant smell, due to the secretions of the glands in the skin, and mostly also to special glands situated in the neighbourhood of the anus. In some forms this abominably smelling secretion is a genuine means of defence.

By the structure and arrangement of their reproductive organs the Carnivora are altogether separated from the insectivores. We do not intend to go into details; and it is enough to mention that the placenta, the organ so important for the nourishment of the embryo, has the form of a belt or muff surrounding the ovum, the ends of which are left free. A placenta of this form is called zonary; and through attaching too much importance to this structure, some naturalists have included the carnivores, the elephants, and the hyrax in the large group of the "zono-placental mammals," greatly to the advancement of a rational system of classification!

Both bones of the lower limbs are always present and distinct. Those of the wrist and ankle, as well as of the metacarpus and metatarsus (the bones corresponding to those of the palm of the hand and the sole of the foot), are also quite distinct, and in general can be moved about pretty freely among each other. The toes are free, often connected only by a swimming-web, and are armed with sharp hooked claws, which in the burrowing and climbing species are long and powerful, in the runners shorter and blunter, and in the Felida and many of the Viverrida are really terrible weapons. In these last forms they are capable of being retracted along with the last joint of the toe within membranous sheaths or folds of the skin on the upper surface of the foot. In this manner they are protected from being worn away in walking, while they can be protruded at will by means of powerful muscles whenever the animal wishes to put them to their natural use as razor-like cutting instruments. They thus form even more dangerous weapons than the teeth.

The mode in which the limbs are held in walking is very various, and serves as a means of distinguishing the larger subdivisions.

The massive and rather clumsy Carnivora, such as the bears, for example, place the entire sole of the foot as far as the ankle on the ground. The impression of their feet, their tread, somewhat resembles that of man or the Simiæ. These are the "sole-walkers" (Plantigrada). Those forms, on the other hand, which have more flexible limbs and more slender bodies, such as the cats and dogs, place only the ends of their toes on the ground; the whole weight of their body rests in walking on the joint between the second and the last of the small bones of the toes. These are "finger-walkers" (Digitigrada). Between these two extremes there are many intermediate grades. The martens, for example, place the whole length of their toes and the metacarpal or metatarsal region on the ground, keeping only the ankle (or wrist) elevated; they have consequently been called Semiplantigrada. Most of the Viverrida, on the other hand, are Semiplantigrada which keep the metacarpus and metatarsus also elevated. These finer distinctions, however, are all the less capable of being maintained since some species are semiplantigrade in front, and completely plantigrade behind. Naturalists have accordingly only retained the designations for the structures adapted to the very different modes of progression at the two extremes. The plantigrade form was without doubt the original mode of progression of the primitive carnivores; only gradually have the ankle, the metacarpus (or metatarsus), and lastly, the first two joints of the toes been raised above the ground.

In most cases the feet have five free toes. The number may, however, sink to four either on one or both pairs of limbs. But the reduction is carried no further. Among the carnivores we know no forms, such as are found in many other orders, having feet with three or two toes, or even with only one.

The dentition is even more characteristic than the structure of the foot. It is distinguished first of all by the remarkable constancy in the number of the teeth, which are all placed in the front portion of the jaws. With the exception of a single species, the sea-otter (Enhydra), all the Carnivora have in each half of the jaw both above and below three incisors and one canine. The only variations are in the number of the molars and premolars. The small close-set vertical incisors have, for the most part, chisel-shaped crowns, and are admirably adapted for gnawing bones. The crowns are frequently so notched that the series has the appearance of a saw. The middle incisors are the first to appear, and the outer ones the last.

The canines, sometimes simply conical and straight, are mostly recurved, very sharp, laterally compressed, with a sharp hinder edge, and often notched like a saw. They always overtop the crowns of the other teeth, even when they are poorly developed, and when the mouth is closed they fit into corresponding gaps or diastemas in the opposite jaws, sliding past each other in order to do so. The canine of the lower jaw, usually not so powerful as that of the upper, gets inserted in a diastema between the incisors and the upper canine, while this upper canine fits into a diastema between the lower canine and the first of the lower premolars. The size, strength, and sharpness of the canines correspond to the greater or less degree of ferocity in the disposition of the animal.

The premolars and molars are usually close enough together at the base to form a continuous series; but their crowns have high cusps and points, and the teeth of the opposite jaws usually correspond to one another in such a manner that each tooth fits into the interval between two teeth in the opposite jaw when the mouth is closed.

There has been much controversy as to the significance of the molar teeth in the Carnivora. Many naturalists direct their attention in a one-sided manner to the form of the individual teeth, while others attach most importance to their development from the milk-teeth. It must indeed be admitted that in many cases we can scarcely resort to this latter character, since the milk dentition is frequently unknown, especially in the case of extinct types. It is clear that only very rarely by some lucky accident we can become acquainted with the deciduous dentition of a fossil genus.

With reference to the form alone, three kinds of molars have been distinguished among the carnivores still living. Behind the canine come the premolars, which are mostly furnished with only a single median cusp, which is sometimes conical, mostly sharp, and in many cases accompanied by small lateral cusps, which, though less prominently developed, are not less sharp. The premolars as well as the incisors and canines belong to the milk dentition. In no living carnivore does the number of these premolars exceed four in each half of the jaw; but this number may be reduced to two or even to one. Some of these teeth which are still present in the young animal afterwards drop out, as, for example, in some bears. After these premolars, which usually increase in size from before backwards, there almost always follows a peculiarly formed tooth known as the **sectorial** or **carnassial** tooth. It is usually the strongest tooth in the whole set, shaped like a sharp blade, divided mostly into two, sometimes more, lobes, and in almost every case provided with a heel or process running inwards. The carnassial teeth of the upper jaw close above the lower ones when the mouth is shut, and these four teeth form in this way the four blades of two pairs of shears, which are just as sharp as instruments made of steel. If the canines are fitted by their form to transfix and hold fast, if the premolars tear the prey into fragments, the carnassial teeth cut and divide it like shears, and since they are seated far back in the jaws, which form single levers, they can be worked with inexpressible force. Under the action of the carnassial teeth the bones are crunched, and the form of these teeth is all the more complicated the greater the ferocity of the animal to which they belong.

Behind the carnassial tooth there is a varying number of so-called tubercled teeth, never more than three, however, and sometimes these are altogether wanting. These are broad teeth with rather flat crowns, mostly studded with blunt tubercles, and often resembling human molars. Their uneven surface manifestly shows that they are intended for crushing or bruising the food, and they are more numerous and stronger the more omnivorous the animal is.

On comparing the dental systems of all

living and fossil carnivores, we are led to the conclusion that since the beginning of the Tertiary epoch two series have been going on developing, two series originally represented by two families now extinct. Of these one, the Arctocyonida, were more omnivorous, while the other, the Hyænodontida, approached the carnivorous marsupials in the form of their sharp cutting molars. The genera belonging to both of these families have all 44 teeth, and in the Hyænodontida there were at least 5 premolars, the two last of which had the form of carnassial teeth. Throughout the whole series of the Carnivora the carnassial tooth of the upper jaw appears to have belonged both to the milk and the permanent dentition, while the lower carnassial in most cases belongs solely to the permanent set.

It is manifest from this fact that the form and origin of the teeth do not correspond to one another, and that the authorities who rely solely on the one or the other of these characters for their determinations cannot come to an agreement.

However that may be, so much remains certain, that the modifications which the Carnivora exhibit in their dental systems are due primarily to the diminution in the number of the teeth, which goes hand in hand with a special adaptation of the structure of the teeth to definite purposes. In the old families the numerous premolars pass gradually over into the likewise numerous molars. In the families of the present day the differences in form are more marked and the number of the teeth is diminished, whether through the loss of premolars or through that of true molars or tubercled teeth. At the present day only one carnivore has as many as 44 teeth, but the dogs and the bears (Canida and Ursida) have 42, and in this number there are as many tubercled teeth as in the extinct Arctocyonida. The diminution is continued in the racoons, which have 40 teeth, and in the badgers and kinkajous, which have 36; but in all these groups the omnivorous character indicated by the tubercled teeth is preserved, even though these are reduced in number.

The Viverrida with 40 teeth have preserved in their dentition manifest traces of one of a marsupial type, but one which is in the highest degree carnivorous in character, and this character becomes more prominent in the hyænas with 34 teeth, and still more so in the members of the cat tribe (Felida), the most carnivorous of all, with only 30. In this series it is easy to trace the decline of the tubercled teeth and the diminution in number of the premolars, processes which culminate in the Machairodus, that formidable giant feline of Pliocene and Quaternary times, in which the premolars are reduced in number and size, and the dentition is almost confined to the long, sharp, dagger-like canines and the powerful carnassials, far back in the jaws.

All these relations of the dentition are so constant that we can only point to three exceptions among all the numerous carnivores. The sea-otter has only 32 teeth, while the other otters have 36. It is the only carnivore which has only four incisors instead of six in the lower jaw. The earth-wolf of the Cape (Proteles), which resembles the hyænas in so many respects, has only 30 teeth, just as many as the cats, but its back teeth are so insignificant and ill-formed that they seem as if they had been hindered in their development; they stand apart from one another, and one can distinguish among them neither premolars, nor carnassials, nor tubercled teeth. Finally, a small animal belonging to Patagonia, having the general appearance of a weasel, an animal called Lyncodon, has only 28 teeth, having one premolar less than the Felida, whose dentition presented the smallest number of highly specialized teeth known before the discovery of the Lyncodon.

The mode of life of the Carnivora is just as varied as that of the animals on which they feed. All live at the expense of weaker animals than themselves; but their means of providing themselves with their food are very different. Some hunt alone or in pairs, others in larger or smaller companies. Some hunt only by day, others only by night. Some resort to cunning, others rely solely on their strength, others depend on their speed. There are certain carnivores which pursue their prey running, while others crawl up towards it and then seize it by a sudden bound. Some are agile climbers and live mainly in trees, others are very expert swimmers and divers, and others again economize their strength, and in order to obtain their prey trust only to inexhaustible patience and to stratagem. There is almost always one of the senses more highly developed than all the others. Most frequently it is the sense of smell that guides them, often also that of hearing, sometimes only the sense of sight.

The mental qualities and the disposition are just as varied as the food. Those which feed on living animals are frequently bloodthirsty and kill more than they can consume. The carrion-eaters are voracious and cowardly. The vegetable-feeders have a gentle disposition.

In general the robber must be more intelligent than the robbed. We have accordingly just as little reason to be surprised at the highly developed intelligence of certain carnivores as at the ease with which some of them make themselves the associates of man. To this order man owes his oldest and trustiest domestic companion, the dog.

But it would be superfluous to enter here into further details, which we reserve till we come to the more thorough examination of the individual types. We regard this great order as made up of six families: the Dogs (Canida); the Hyænas (Hyænida); the Cats (Felida); the Viverrines (Viverrida); the Bears (Ursida); and the Martens (Mustelida).

THE DOG TRIBE

(CANIDA).

Digitigrade carnivores with long running legs, five free toes on the fore-feet, four on the hind-feet, and in most cases 42 teeth.

This large family, distributed over the whole world, is easily recognizable even in its most divergent forms. The not very large head carries in all wild members of the family erect, pointed, very mobile ears, often very large, and wide open eyes, and is produced into a longer or shorter muzzle, at the end of which open the wide mobile nostrils. The wide mouth is surrounded by thick fleshy lips, on which are set sparsely scattered tactile hairs. The long broad fleshy tongue serves to lap up liquids. The vertebræ of the strong fleshy neck have broad and high processes for the attachment of the powerful muscles. The small laterally compressed chest and insignificant trunk are supported by straight legs, which are relatively longer than in other carnivores. The toes are mostly armed with a few curved claws, which get worn away in running. On the sole of the feet are callous pads covered with a thick rough skin. The tail, generally long, is often shaggy. The fur is pretty thick, but only rarely of much value to the furrier; in certain parts the hair is elongated so as to form a mane or long tuft. There may be as many as ten abdominal teats, and the number of the young born at one time is often very considerable. The coat is seldom brightly coloured or marked; in general the prevailing hue is a dull gray, which may pass over into yellow, brown, or red.

The dentition offers little variety. In the majority of the Canida the incisors are narrow and sharp. The upper ones often show a median cusp, with two side cusps, separated by not very deep incisions, while the lower ones have only a notch in the middle. The canines are seldom very strong, but often curved, slender, and flattened at the sides. Both above and below there are four premolars in the milk dentition, and the last of these in the upper jaw is the carnassial tooth. The others both above and below increase in size from before backwards. They are all single-cusped. The upper carnassial has a large oblique cusp in the middle, the lower is two-lobed. The tubercled teeth diminish in size from before backwards; the first is always very large and mostly quadrangular in form. The general formula is—Milk dentition $\frac{3 \cdot 1 \cdot 4}{3 \cdot 1 \cdot 4} = 32$; permanent dentition $\frac{3 \cdot 1 \cdot 4 \cdot 2}{3 \cdot 1 \cdot 4 \cdot 3} = 42$. Exceptions are met with only as regards the number of the true molars or tubercled teeth. Some wild dogs belonging to India, which have been formed into the genus Cyon, have only two molars in the lower jaw, accordingly only 40 teeth in all, while a remarkable South African dog with large ears, *Otocyon caffer*, has always four tubercled teeth below and three or four above, which brings the total number of its teeth up to 46 or even 48, a number which exceeds that of almost all other placental mammals.

Essentially carnivorous in their diet the Canida are in general not so bloodthirsty as the cats (Felida) or martens (Mustelida). Many of them not only do not despise carrion, but even show a decided fondness for it, and prefer tainted game to fresh meat. In a domesticated state they can certainly easily be accustomed to any kind of diet, but with the exception of certain species most of the wild Canida abstain from vegetable food, and their strong tubercled teeth serve rather to masticate flesh and crush bones. Yet there are some few species which manifest a decided preference for a vegetable diet.

All the Canida chase living prey, the great majority of them by night, but some also by day. While resting they remain in clefts in the rocks and other holes and corners. Some excavate underground recesses with passages leading to them. They hunt most frequently in troops, often very numerous ones, seldom singly or in pairs, and they know how to concert plans of attack so as to cut off the retreat of their destined prey. Their extraordinarily keen scent is what guides them and furnishes them with their chief notions about the objects around them. The sense of hearing is only of secondary importance, and is most highly developed in those species which live in great deserts. The sight is only a slightly developed subsidiary sense. In order to gain an accurate knowledge of any object the dog must sniff it all round. Its memory is based on its smell.

I am speaking here only of wild dogs. With few exceptions they are all cowardly beasts, which never, even when urged by hunger, attack singly animals with which they might have to wage any serious battle. But in these cases they assemble in troops, to break the resistance, and when once their prey has been overpowered by their united strength, they show their cruelty and ferocity even in devouring those of their own kind which may have been wounded in the struggle.

Wild Canida do not bark, but howl. Scarcely any sounds uttered by animals are more unpleasant to hear. The howling-monkeys alone can rival wolves or jackals in the diabolical music which they create.

The glands of the skin are very highly developed, and besides the numerous sebaceous or fat-secreting glands which are found everywhere, the Canida have either a single large gland at the root of the tail (like the fox) or several smaller scent-glands. All the Canida likewise have a peculiar gamy smell, often sufficiently penetrating, and all the more persistent since this family exhibit none of the cleanly instincts for which the cat tribe are remarkable.

None of the Canida are tree-climbers. They hunt down their prey by the rapidity of their course in the open ground. Only seldom do they resort to stratagem. Some species crouch and crawl so as to approach their prey, and have even acquired a certain reputation on account of the "thousand tricks" by which they outwit their victims, but in general the Canida make after their game in full chase.

The Canida are very prolific. Half a dozen young at a birth is the average, and this average may be considerably exceeded. The young come into the world with closed eyes, and are mostly tended by the mother alone, which for a long time watches over them with the utmost solicitude, and is often even compelled to defend them against the father.

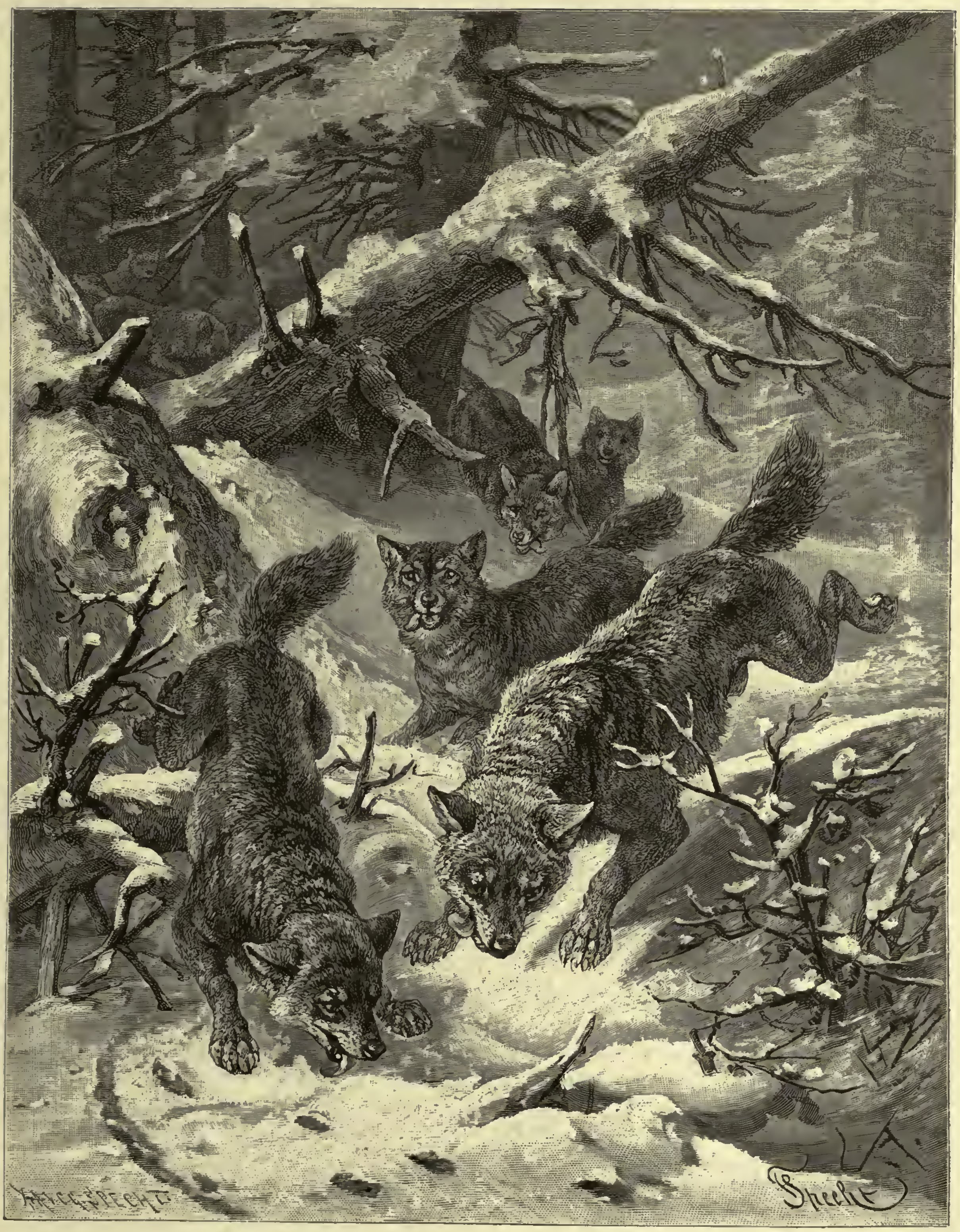
Though it cannot be denied that the wild Canida have a pretty highly developed intelligence, yet we should not overestimate their capacities, which do not surpass those of the other Carnivora. Neither in the chase nor in their modes of defending themselves against enemies do they exhibit any very high endowments. We should be careful not to ascribe to the wild species qualities which the domesticated dogs have acquired by centuries of intercourse with man. A weasel is not less sly and cunning than a fox, which yet passes in fable for the master of all sorts of wily tricks, and the wild cats are just as astute as foxes in concerting plans of attack, in which they weigh all the difficulties of an enterprise, and take the probabilities of success into consideration. If we leave out of account the training given by man, the effects of which have been inherited and further and further developed for numberless generations, then we can see in the dog only a social carnivore, which has intelligence enough for its business as a hunter in the open field, but no more.

What makes up for all the bad qualities of the dog in the eyes of man is the readiness with which several species of this family have abandoned their liberty in order to place themselves entirely under his rule. This is certainly a very remarkable trait of character, and all the more so since it has been found in several species natives of widely different countries. But precisely in this fact we see a striking proof of that which we have said about the wild Canida, for the domesticated dogs have, as regards their intelligence, neither more nor less than man has put into them.

The family of the Canida is very numerous, and the species are all the more varied in character since the family is distributed over a vast geographical area. Founding on the essential differences in the structure of the teeth and feet we may distinguish four genera: the **Dogs Proper**, forming the genus Canis, with 42 teeth; the genus **Cyon**,[1] with 40 teeth; the genus **Otocyon**, with 48. These three genera have all five toes on the fore- and four on the hind-feet. Lastly, the **Cape Hunting Dogs**, forming the genus Lycaon, which have only four toes on all the feet, while their dentition does not differ from that of the dogs proper.

Since these latter are the most numerous, several subgenera have been distinguished, but these cannot be regarded as well established. The subdivision into **wolves**, with a round pupil, and **foxes** with a vertical slit for the pupil, is still that which is most generally accepted. It must be admitted, however, that there are connecting links between the two extremes as regards the form of the pupil.

[1] The smaller number of teeth in the genus Cyon or Cuon (called by some naturalists Chryseus) is due to the absence of the second tubercled tooth on each side of the lower jaw. To this genus belong the kholsun or dhole of Western India (*Cyon dulchuensis*), and the buansuah of Northern India (*Cuon primævus*).—Tr.



To face page 136.

PLATE VI. — A PACK OF WOLVES (*Canis lupus*) IN PURSUIT OF PREY.

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

THE DOGS PROPER

(CANIS)

With five toes in front, four behind, and 42 teeth.

The Group of the Wolves (subgenus *Lupus*).

With round pupil; includes the strongest species with the longest legs.

Our common **Wolf** (*Canis lupus*) may serve as the type of the whole group. A highly social animal, the wolf is distributed over all Europe, all the continent of Asia except the hot regions, and all North America, in one word, over all the cold and temperate regions of both hemispheres. High mountains are seldom visited by it except as places of refuge, when it is driven away by the civilization of the plains. It prefers the wild tracts of moderately high mountains, and of plains where forests afford a secure retreat, and in general can make itself comfortable anywhere, if only it can find a good resting-place and abundant food. Man has driven it away wherever he could, and in England it has been extirpated. In our days it is chiefly in western Europe, in the Jura, the Ardennes, and the maritime mountains of Northern Spain where it still roams about in small troops, while in the East, in Poland, Russia, and Hungary, it still forms large flocks, which in time of war press further west in the train of the armies.

The wolf cannot be better described than by saying that it is like a large lean slim dog with a thick head, pointed muzzle, and shaggy hanging tail. The legs are thin, the paws narrow, the fur abundant and thick in northern countries during the winter, of a yellowish-gray colour, sometimes inclining to red, yellow, or black. Like all animals with a wide distribution the wolves have coats which vary very much according to the country and the season of the year. In general the fur is highly esteemed as a shaggy sort. The tail is never so well covered with hair as that of the fox.

In spite of the reputation for coarse stupidity, which has been created for it by the writers of fables, the wolf is an untiring cunning hunter, which in all its hunts traverses considerable stretches of ground. It seeks out carrion as well as living victims.

In summer it is almost always to be found alone, or accompanied only by a female, but in winter the pairs unite into large troops, sometimes numbering more than a hundred individuals. After sunset they call to one another by uttering a frightful whining howl most disagreeable to hear, and the chase lasts the whole night through. By day the wolf rests in dense underwood, in fissures in the rocks, holes in the snow, or amidst the reeds on the margins of ponds and marshes.

The wolf goes where hunger calls. In winter he approaches the dwellings and stables, in summer he prefers to hunt in the woods. Fainthearted and cowardly when alone, he often takes to flight in the most ridiculous manner on the slightest occasion; but when combined into a tolerably numerous troop, the same animals show themselves to be daring, reckless, and terrible in the last degree. He flees from man, especially where he has made acquaintance with fire-arms; nevertheless the stories told of the "wer-wolf" are not altogether without foundation. There were mad wolves which, just like mad dogs, fell upon all that came in their way.

The wolf has just as keen a scent as the best hunting hound, and is just as expert in following a trail. Plate VI. depicts a band of wolves so occupied. The wolf is sly, clever, and patient. When he hunts alone he follows his victim with remarkable perseverance and certainty. For hours at a time he lies in wait beside the well-known tracks of his prey, and always manages to overcome the obstacles which he finds in his way. It is an established fact that a pack of wolves draws up regular plans of attack, and the members of it come to a mutual understanding as to their respective roles. If they have once combined for any enterprise against other animals which are capable of defending themselves, they lend each other aid. It is said that they devour their dead and wounded comrades, but other observers deny that they have these cannibal habits. Perhaps this difference of opinion is due to the fact that the wolf behaves differently in different situations. The hunger of the wolf has become proverbial, and the wolf is not the only animal in which hunger can materially prejudice love to one's neighbour.

The wolf kills more than his hunger requires, at least more than is necessary for his immediate wants, but not beyond what is necessary to satisfy the future demands of his appetite, which he always takes prudently into consideration; for what he cannot eat to-day he can perhaps consume in eight or ten days. He devours everything, both fresh meat and carrion, and even manifests a preference for the latter. Mammals and birds, reptiles and amphibians, and even the dried stockfish of northern lands, seem to come all alike to his little-spoiled palate. It is even said that when hard pressed by hunger he does not despise maybugs, or pumpkins, or fresh heads of maize. For domestic dogs and foxes, his nearest blood relations, the wolf appears to have a peculiar relish, and the former repay the hatred which he owes them in full measure. In pastoral countries bands of wolves attack not only sheep and goats, which are their ordinary victims, but even considerable herds of cattle and horses, from which they try to separate a single individual in order to overwhelm it by a combined attack. In other parts the wolves commit great ravages among game, attacking even the moose and the wild boar. In the North they follow the migrations of the lemmings; in the mountains they endeavour to break into stables and inclosures.

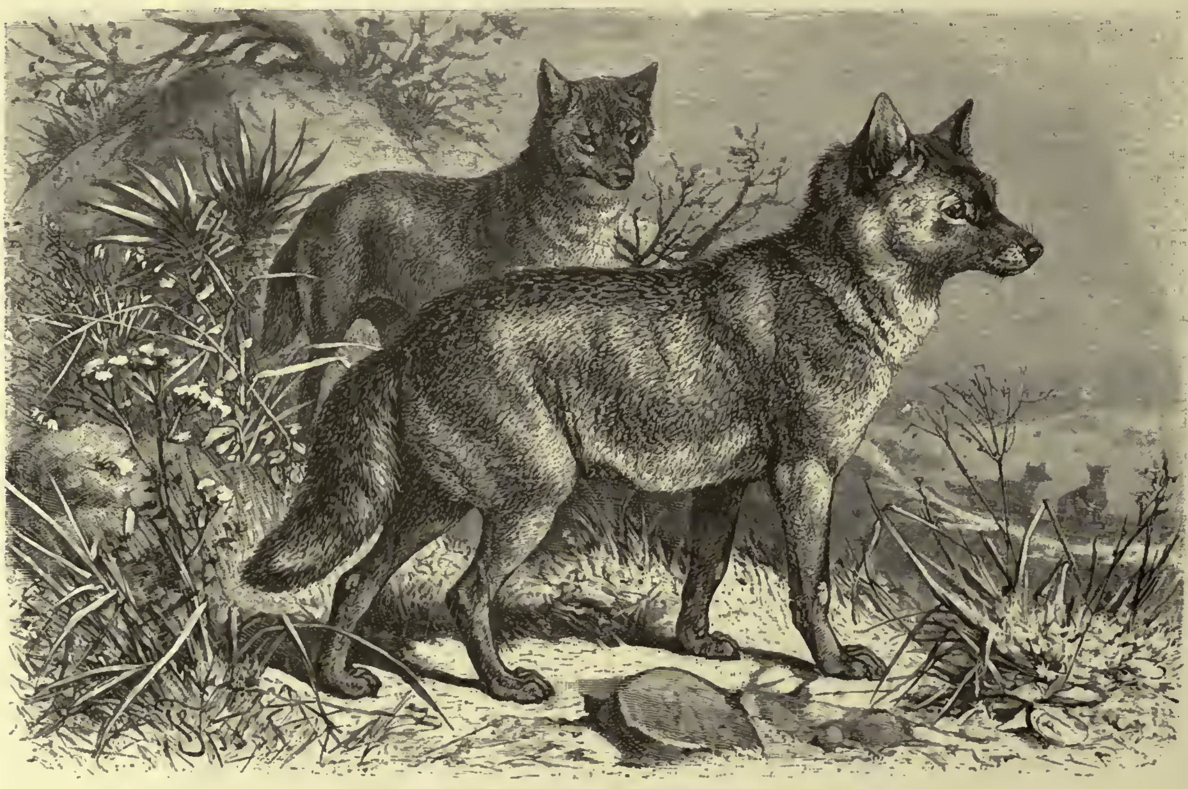


Fig. 57.—The African Wolf (*Canis lupaster*).

Where wolves are abundant they become a real plague through the ravages which they commit among flocks and herds, and especially sheep, as well as through their attacks on man. Among undomesticated animals only

UNIVERSITY
OF
CALIFORNIA

powerful bulls, the auerochs, the half-wild horses of the steppes, tarpans, and boars can withstand their onsets. On account of these depredations the wolf is implacably pursued by man. All methods seem good which help towards his extermination. Poison, firearms, snares and traps, and battues with well-trained dogs are all resorted to for the purpose. Wolf-hunting formerly stood, and in some countries still stands, in high honour.

The female wolf gives birth in spring to from four to six young, which remain blind for three weeks and are suckled for a pretty long time. Wolfs are easily tamed while young, but must be well looked after and kept isolated when they attain the age of puberty, for they become wild again when they hear other wolves howl. In spite of the rooted hatred between dogs and wolves these animals often unite and produce hybrids, which are mutually fertile. In many districts the race of the wolf-hounds is even said to be recruited by this process of bastardizing.

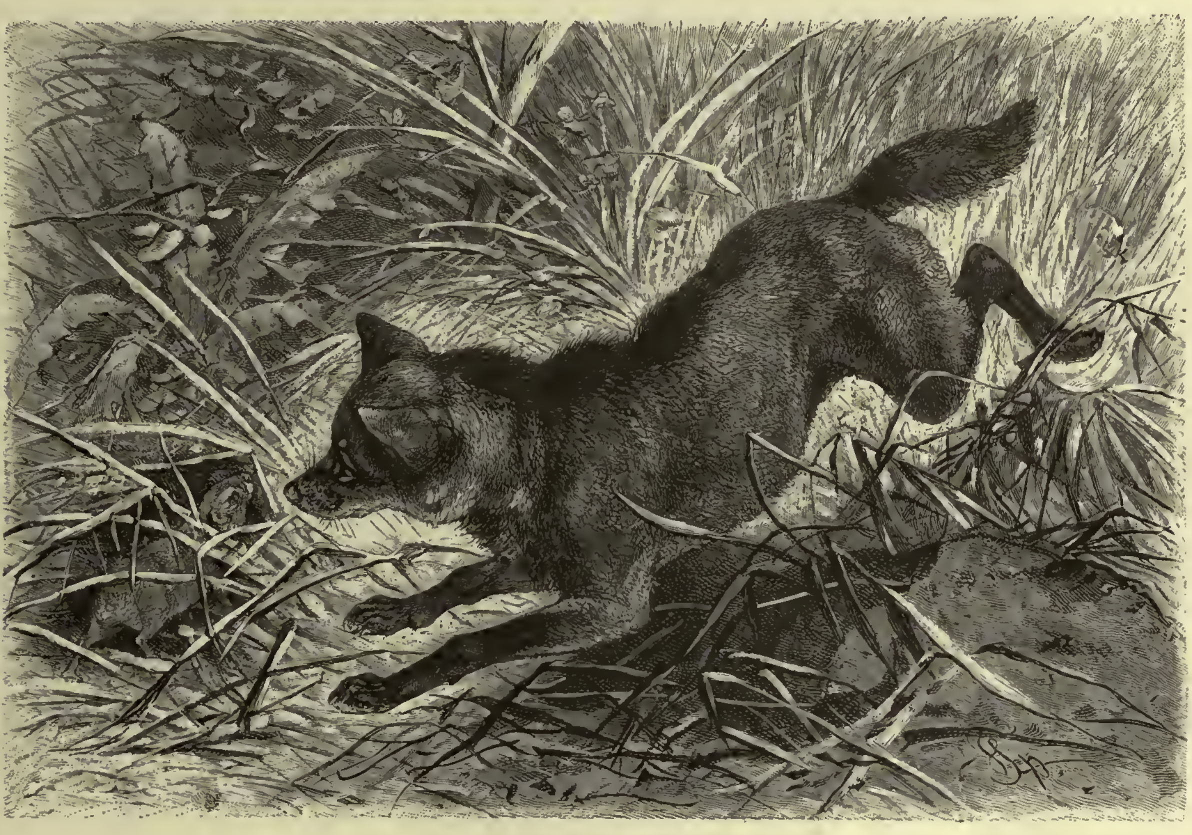


Fig. 58.—The Maned Wolf (*Canis jubatus*).

Fig. 57 gives a representation of the **African Wolf** (*Canis lupaster*), which ranges over the whole of the north and the centre of the continent, and is distinguished from the European wolf by its inferior size and strength, its larger straight ears, a tolerably bushy tail, and a brownish colour. The ancient Egyptians have represented this wolf on their monuments. It sometimes commits considerable devastation among sheep and goats, but mostly lives on smaller prey and on carrion, which it prefers to any other kind of food.

The **Maned Wolf** (*C. jubatus*), fig. 58, of South America is of the size of our wolf, but weaker, and has longer legs. The ears are larger, the tail shorter, the anal glands more developed than in other wolves. It is of a cinnamon-brown colour, but has a black face and black paws, and a white spot on the throat. A mane of stiff hair covers the nape of the neck and the back. It lives chiefly on agoutis and guinea-pigs, but eats also much fruit; it attacks sheep but rarely. This extraordinarily shy creature, which hunts only by night, has generally managed to withdraw itself from the observations of travellers.

The **Coyote** or Prairie-wolf (*Canis latrans*), fig. 59, which ranges throughout North America as far as Mexico, approaches the foxes in the form of its long bushy tail, its sharp snout, and rather short legs. Its thick fur is of a yellowish-gray colour. Its mode of life altogether resembles that of our wolves. The only difference to be noted is that the female excavates a subterranean hole in which to give birth to her young. Its howling, barking, and whining can be heard to a very considerable distance.

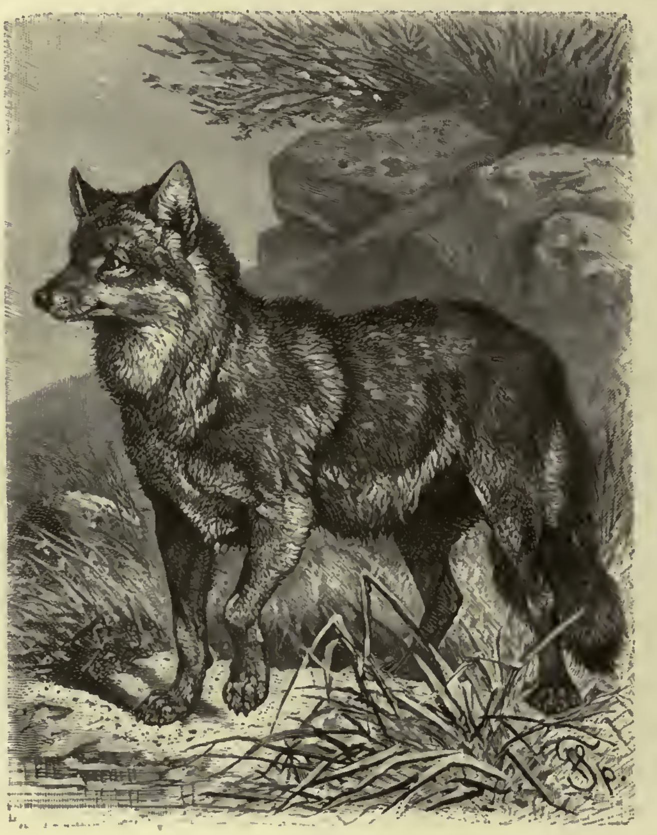


Fig. 59.—The Coyote or Prairie-wolf (*Canis latrans*).

The following is taken from a paper by Dr. Coues in the *American Naturalist* (1867), as quoted in the official report by Drs. Coues and Yarrow on the Collections of Mammals in portions of some of the Western States of America.

"The Prairie or Barking Wolf (*Canis latrans*, Say) is by far the most abundant carnivorous animal in Arizona, as it is also in almost every part of the West. Practically, the coyote is a nuisance; theoretically, he compels a certain degree of admiration, viewing his irrepressible positivity of character and his versatile nature. If his genius has nothing essentially noble or lofty about it, it is undeniable that few animals possess so many and so various attributes, or act them out with such dogged perseverance. Ever on the alert, and keenly alive to a sense of danger, he yet exhibits the coolest effrontery when his path crosses ours. The main object of his life seems to be the satisfying of a hunger which is always craving, and to this aim all his cunning, impudence, and audacity are mainly directed.

"Much has been written concerning the famous polyglot serenades of the Coyote by those who have been unwilling listeners, but it is difficult to convey an adequate idea in words of the noisy confusion. One must have spent an hour or two vainly trying to sleep before he is in a condition to appreciate the full force of the annoyance. It is a singular fact that the howling of two or three wolves gives an impression that a score are engaged, so many, so long-drawn are the notes, and so uninterruptedly are they continued by one individual after another. A short, sharp bark is sounded, followed by several more in quick succession, the time growing faster and the pitch higher, till they run together into a long-drawn lugubrious howl in the highest possible key. The same strain is taken up again and again by different members of the pack, while from a greater distance the deep melancholy baying of the more wary Lobo[1] breaks in to add to the discord, till the very leaves of the trees seem quivering to the inharmonious sounds. It is not true, as asserted by some, that the coyotes howl only just after dark and at daylight. Though they may be noisiest at these times, when the pack is gathering together for a night's foraging, or dispersing again to their diurnal retreat, I know that they give tongue at any time during the night. They are rarely, if ever, heard in the daytime, though frequently to be seen, at least in secluded regions. Ordinarily, however, they spend the day in quiet out-of-the-way places, among rocks, in thick copses, &c., and seek their prey mainly by night, collecting for this purpose into packs, as already noticed."

[1] The American, Timber, or Buffalo Wolf (*Canis lupus occidentalis*).

The **Jackal**, the Dib of the Arabs (*C. aureus*), is to be seen in Plate VII., where it is represented in company with hyænas, to which he is said to act as guide. Since he can scent carrion at great distances, the natives maintain that without his aid the hyænas would die of hunger in consequence of the dulness of their senses. Is this explanation correct? I cannot say. But the fact is that when the yelping of jackals is heard, one has not to wait long in order to hear the laughing and harsh cries of the hyæna.

The stories told by us of the fox are told by the Arabs of the jackal. Among the animals of Northern Africa it is regarded as the type of cunning, malice, treachery, and shamelessness. But while our fox carries on its depredations in silence, the jackal has full claim to its Arabic name, which signifies "howler." It is a truly diabolical music, which goes on from sunset to dawn, which has something melancholy and pitiful in its sound, and becomes simply intolerable when the band is numerous and hungry. Sometimes the jackals utter a distinct bark.

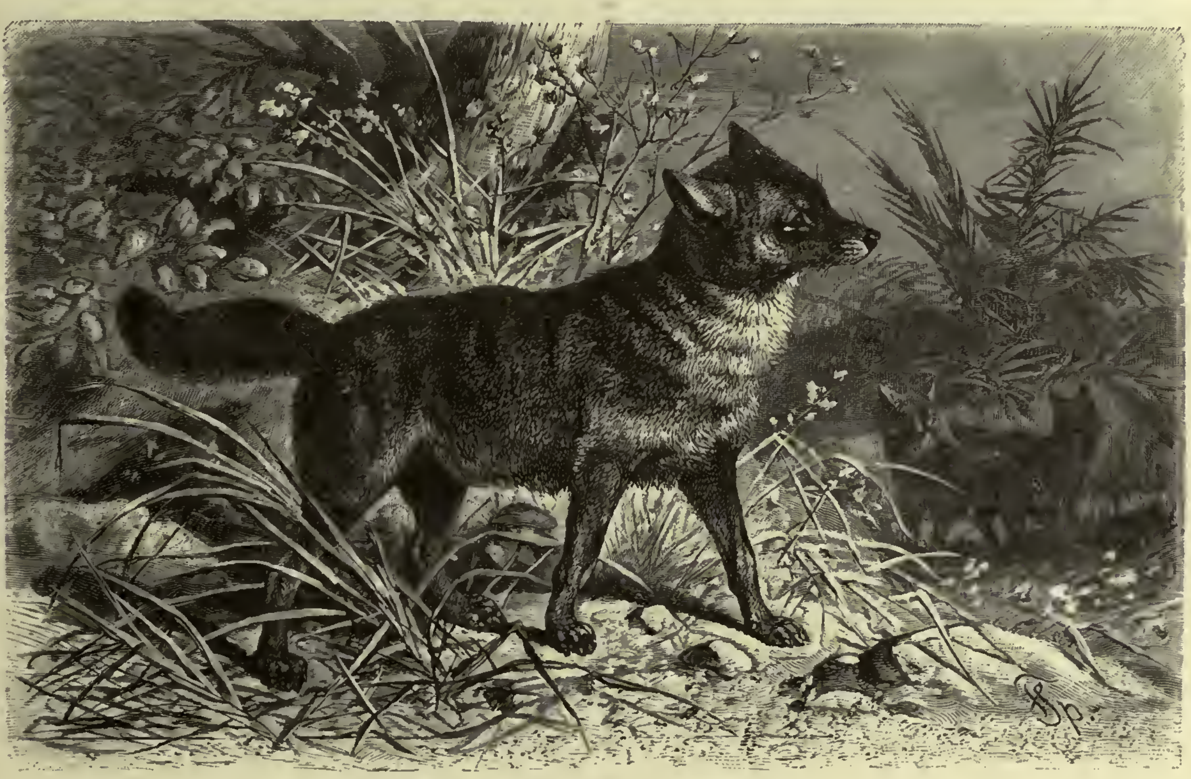


Fig. 60.—The Slender Jackal (*Canis anthus*).

The long fur, of a dirty yellow on the back, and more copper-coloured on the sides, gives the jackal somewhat of the appearance of the fox, from which it is distinguished, however, by its longer legs and round pupil. It extends from India through Persia and Asia Minor to Northern and Central Africa, and is found also in Greece, and even in Dalmatia; and everywhere it is the same animal, universally detested and universally pursued. Of a variety, the **Slender Jackal**, which some even regard as a species under the name of *Canis anthus*, a variety recognizable by its gray fur and longer and slimmer legs, an illustration (fig. 60) is furnished for this reason, that the greyhounds of the Arabs (the *slugi*) are probably descended from it.

Jackals always assemble in troops, and slay and ravage every creature that they are a match for. Instead of the few domestic fowls, with which, in spite of all their cunning and wiliness, they must for the most part content themselves, they would, no doubt, levy tithes on the goats and sheep of the natives, if it were not for the dogs, which pursue them with fury. Disgusting, filthy, ill-smelling animals, they put up in case of necessity with any kind of nourishment, even with the excrements of other animals. They follow travellers and caravans, and know very well how to estimate the dangers that may threaten them. The post-cars in Algiers cause them no fear, as I have myself been able to observe. A jackal which was quietly observing us swiftly made off when the guide, who had remained a little behind, drew his revolver out of his pocket.

Perhaps we have been too lavish of our examples of Canida with round pupils. But apart from the fact that we are far from having exhausted the number of known species, since numerous other species are to be found in all countries from which we have adduced examples, a strong interest attaches to these animals from the fact that among them the stocks of our numerous races of domestic dogs are to be sought.

Several facts have to be considered in determining the question so frequently discussed as to the origin of our domestic dogs, the individual races of which differ much more among themselves than the species of wild dogs known to us. These races, which undoubtedly have been produced by selection by man, would certainly be regarded partly as species, partly even as forming distinct genera, if they were met with in the wild state. There is no organ in their body which has not varied indefinitely through artificial breeding, and there are only two common characters which can be conceded to them—the round pupil and the bearing. The wild species carry the tail low, almost dragging; the domestic varieties carry it high, often bent up towards the back, and in this case mostly on the left side. This last character is indeed the only one which was recognized by Linnæus as common to all domestic dogs.—The modification of the races in the hands of man cannot be denied. We have too many proofs of the fact to be able to doubt it; and from the representations on the monuments of ancient Egypt and the mummies left behind by the Incas of Peru, down to the present time, we can trace long series of variations, the final goal of which is even yet far from being reached, since the existing races are still being constantly modified, perfected, and multiplied.

Are these races derived from several original wild stocks, or only from a single one, which in the course of centuries has been gradually modified in different directions, and is no longer represented in the wild state? That is a question which different people have endeavoured to answer in different ways.

We must, first of all, here call attention to the fact, that domesticated dogs belonging to different races have been found both in the oldest deposits in which human remains of any kind have been met with, and also by European discoverers in countries into which dogs could not have been introduced from the lands of our ancient civilization. The bone-caves, lake-dwellings, kitchen-middens, and sepulchres of ancient tribes in all parts of the world have yielded remains of domestic dogs; and these remains, as well as the Egyptian frescoes, prove to us that the races reared in different districts were from the first different in form, size, and bearing.

It is incontestable that domestic dogs have never been found in districts in which wild dogs with round pupils have not been found also, and that it is easy to discover in the old or little modified races the marks of these wild species. Where man did not experience the necessity for modifying the wild species greatly, the races which he tamed for his use resemble their wild kindred so much that one can distinguish them only by the bark. The dogs of the Eskimo differ in no respect from the wolves of Labrador, nor those of the Red-skins of the Rocky Mountains from the coyote. No difference could be pointed out between the skull of a dog of the lake-dwellings of Switzerland of the stone period and that of the jackal, none between the skull of a dog of the bronze period and that of an Indian wolf (*Canis pallipes*). Several forms of large domestic dogs represented on the Egyptian monuments bear a remarkable resemblance to the African wolf (*Canis lupaster*); and the small races with straight pointed ears are probably descended from the jackal. The wolf-hounds so valuable to our ancestors had a wonderful resemblance to the wolves which they were employed to hunt. The hatred which the domestic races manifest towards their wild kindred, and they to them, is a trait of character which is always repeated in like cases.

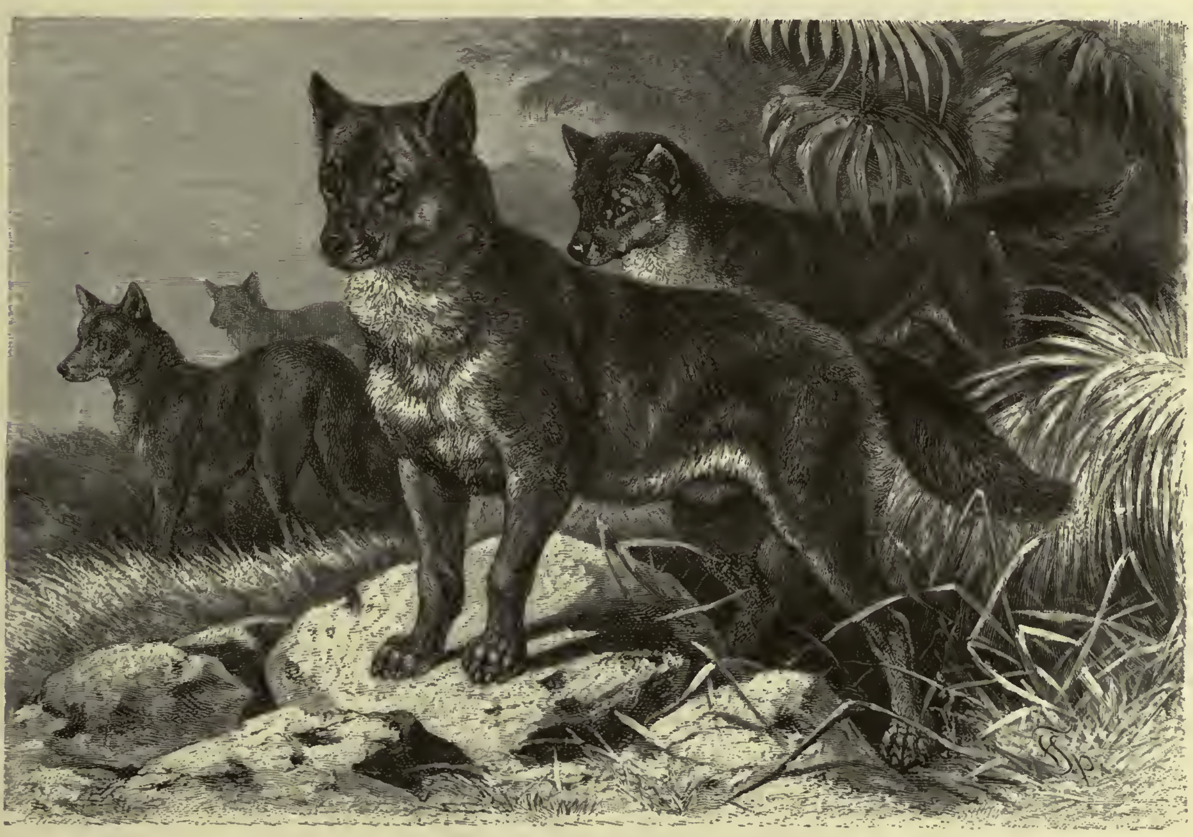


Fig. 61.—The Dingo (*Canis dingo*). page 144.

Notwithstanding their wildness, all species of wild dogs attach themselves readily to man, especially when young, and more or less easily renounce their independence in favour of the master who has brought them under his yoke. This surrender of their independence can most easily be recognized in domestic dogs by the mode in which the ears are held, these being always erect in the wild species, while in many of the domesticated races, on the other hand, they become more or less pendent.

It appears accordingly from the investigations of the present day, among which those carried on with rare perseverance by Prof. Jeitteles of Vienna deserve specially to be mentioned, that all species of wild dogs with round pupils are capable of domestication, and that many of them, some of which are figured and described in this work, have become the ancestors of our domestic breeds. The readiness with which these different breeds sprung from various stocks unite with one another to produce fruitful offspring, has exercised an unmistakable influence on the formation of new races and the perfecting of the old.

These conclusions are strengthened by the fact, that in many countries the neglected dogs which have regained their freedom have acquired characters adapted to the land which they inhabit. These so-called pariah dogs swarm in the East, as, for example, in India. Flocks of them living in freedom form the sanitary police of the towns and villages in which they live, cleansing them of all kinds of filth and garbage. They closely resemble one another, and as the half-wild street-dogs of Cairo resemble the jackals of the country in which they are found, so the pariah dogs of India can hardly be distinguished from the wild jackal which inhabits the same country.

As representative of these degenerate breeds a figure is given of the Australian dog, the **Dingo** (*Canis dingo*), fig. 61. It is a wolf with long legs and bushy tail of the size of a sheep-dog. Dampier found it in a wild condition when he landed in Australia in 1699. It chased kangaroos in not very numerous flocks. From the earliest times the natives have tamed dingos which they have caught young, and have made use of them in hunting marsupials. After the colonization of Australia these dogs attacked herds of sheep by preference, committing great ravages amongst them, and they are hence relentlessly pursued by the colonists.

When tamed they are good watch-dogs, but they cherish a savage hatred towards other dogs and towards Europeans. The fur is a mixture of yellow and black. Hybrids with other dogs are not uncommon, and are esteemed for their strength and endurance.

"The Dingos, or native dogs, 'Warragal' of the aborigines . . . are the wolves of the colony, and are perhaps unequalled for cunning. These animals breed in the holes of rocks: a litter was found near Yas Plains, which the discoverer failed to destroy, thinking to return and catch the mother also, and thus exterminate the whole family; but the 'old lady' must have been watching him, for on his returning a short time after, he found all the little dingos had been carried away, and he was never able, although diligent search was made in the vicinity, to discover their place of removal. The cunning displayed by these animals, and the agony they can endure without evincing the usual effects of pain, would seem almost incredible, had it not been related by those on whose testimony every dependence can be placed. The following are a few among a number of extraordinary instances.

"One had been beaten so severely that it was supposed all the bones were broken, and it was left for dead. Upon the person accidentally looking back, after having walked some distance, his surprise was much excited by seeing 'master dingo rise, shake himself, and march into the bush, evading all pursuit.'—One supposed dead was brought into a hut for the purpose of undergoing 'decortication;' at the commencement of the skinning process upon the face, the only perceptible movement was a slight quivering of the lips, which was regarded at the time as mere muscular irritability: the man, after skinning a very small portion, left the hut to sharpen his knife, and returning found the animal sitting up, with the flayed integument hanging over one side of the face.

"Another instance was that of a settler, who, returning from a sporting expedition with six kangaroo dogs, met a dingo, which was attacked by the dogs and worried to such a degree, that, finding matters becoming serious, and that the worst of the sport came to his share, the cunning dingo pretended to be dead;—thinking he had departed the way of all dogs, they gave him a parting shake and left him. Unfortunately for the poor dingo, he was of an impatient disposition, and was consequently premature in his resurrection: for before the settler and his dogs had gone any distance, he was seen to rise and skulk away, but at a slow pace, on account of the treatment he had received; the dogs soon re-attacked him, when he was handled in a manner that must have effectively prevented any resuscitation a second time."—Bennett: *Wanderings in New South Wales.*

The Group of the Foxes (sub-genus *Vulpes*).

Distinguished from the wolves by their vertical oval pupil, their shorter legs, longer and more bushy tail, larger ears, and more elegant and more pointed snout. The dentition shows indeed the same number and arrangement of the teeth, which, however, seem to be more slender and more elegantly formed, characters which are specially well seen in the long and much curved canines.

These characters, which are easily distinguishable in extreme cases, appear, however, only gradually, and we find transitional forms in respect of all of them.

The pupil becomes more oval, and its transverse diameter diminishes only gradually. We likewise have species with pretty long legs or but slightly bushy tail. The ears present all grades of intermediate forms, between small pointed ears like those of the jackals, and the monstrous ear-flaps of the elegant fenneks of Sahara.

The habits and mode of life vary in accordance with these characters. The species with slit-like vertical pupils are altogether nocturnal. Those with large ears are principally guided by impressions transmitted by the sense of hearing, and are not so good as dogs at following tracks by the scent. The short-legged species do not capture their prey by their speed, but surprise them by cunning; and the weakness of their whole structure induces many forms to provide secure retreats for themselves by burrowing. But all these modifications are slow and gradual, and the connecting line between the extremes can be indicated by numerous intermediate forms.

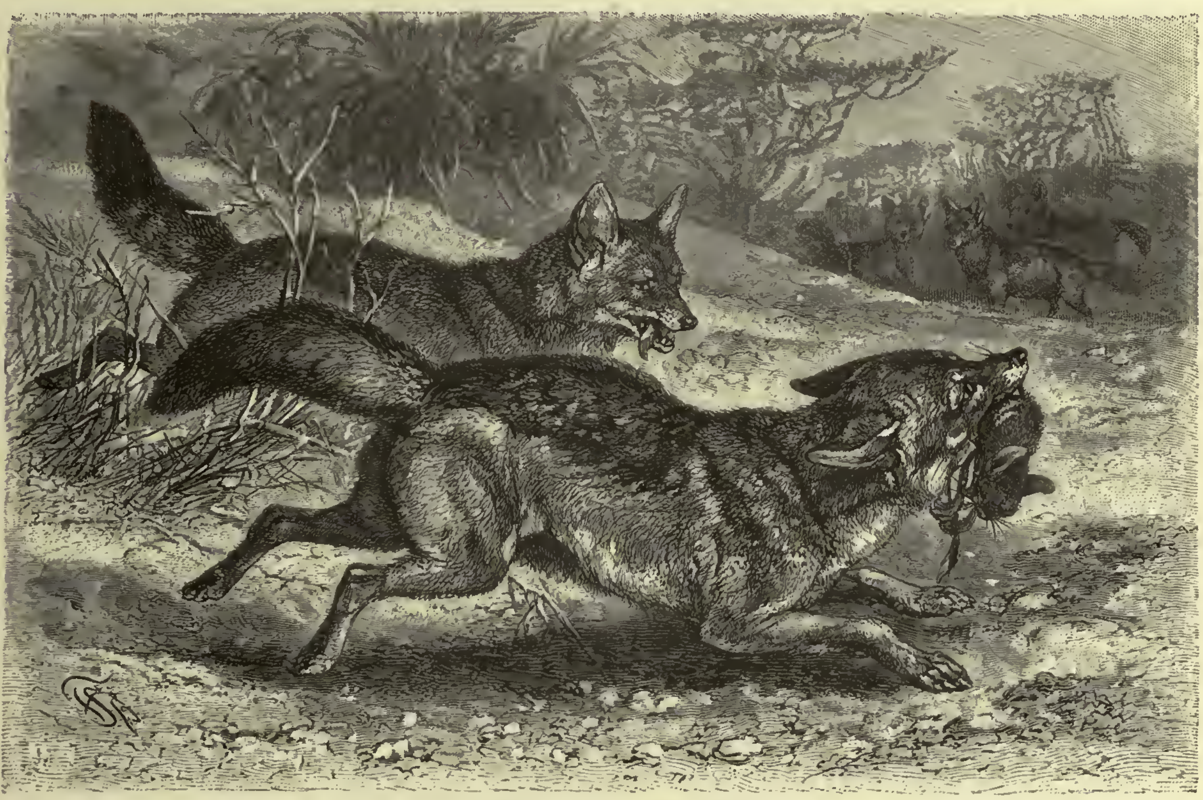


Fig. 62.—The Black-backed Jackal (*Canis mesomelas*).

The **Black-backed Jackal** (*Canis mesomelas*), fig. 62, of South Africa belongs to the number of these intermediate forms. Of the same size as the jackal, it nevertheless approaches the fox in its very sharp snout and rather short legs. The ears are tolerably large, the pupils broadly oval. In colour it resembles a fox, covered with a black shabrack, contrasting strongly with the golden red of the sides. Fond of carrion, this bold and yet wily so-called jackal is given to breaking into villages and camps by night, and makes itself detested by its plunderings in farmyards. It is even accused of eating off the fat tails of the sheep reared in South Africa.

A fox not less detested by the natives is the **Aguarachay** (*Canis Azaræ*), fig. 63, which is distributed over the whole of South America and ascends the Cordilleras to the height of about 10,000 feet. It does not, like our fox, inhabit holes made by itself, but often establishes itself in the burrows dug by the armadillos, and manages to find other suitable places of concealment. It lives chiefly on small mammals and birds, but also attacks young lambs, llamas, and vicuñas, and appears to be quite as cunning as our European species. With this it also agrees in the numerous varieties of colour in the fur, which may be brownish-black, rusty red, gray, or even white. Since young ones of different colours are born at the same time, it is clear that no importance can be attached to these variations. The pupil is somewhat narrower than in the former species, and the legs are somewhat longer than those of the fox. In spite of the hatred to which the aguarachay is subject on account of the severe ravages it commits in the poultry-yard, it is often tamed in Paraguay and even employed in hunting, in which occupation the keenness of its scent enables it to act as a setter with great efficiency.

Our **Fox** (*Canis vulpes*), of which a whole family is represented in fig. 64, may serve as the type of a sub-group, distinguished by a slit-like pupil, short legs, bushy tail, and long slender recurved canines. This animal, which is met with throughout the temperate and even in the frigid zones of both hemispheres, varies considerably in respect both of the colour and the value of the fur. In general those skins are most highly esteemed which are derived from animals inhabiting cold regions and killed in winter. The colour of the fur likewise has a great influence on its commercial value. The very young animals are almost black; the yellow colour increases with age; and the pale yellowish red, frequently with a dark stripe along the back, prevails in adult animals. But the utmost variety of shades, from black to white, from red to gray, and from brown to yellow, may occur according to the country, the season, and other still unknown circumstances.

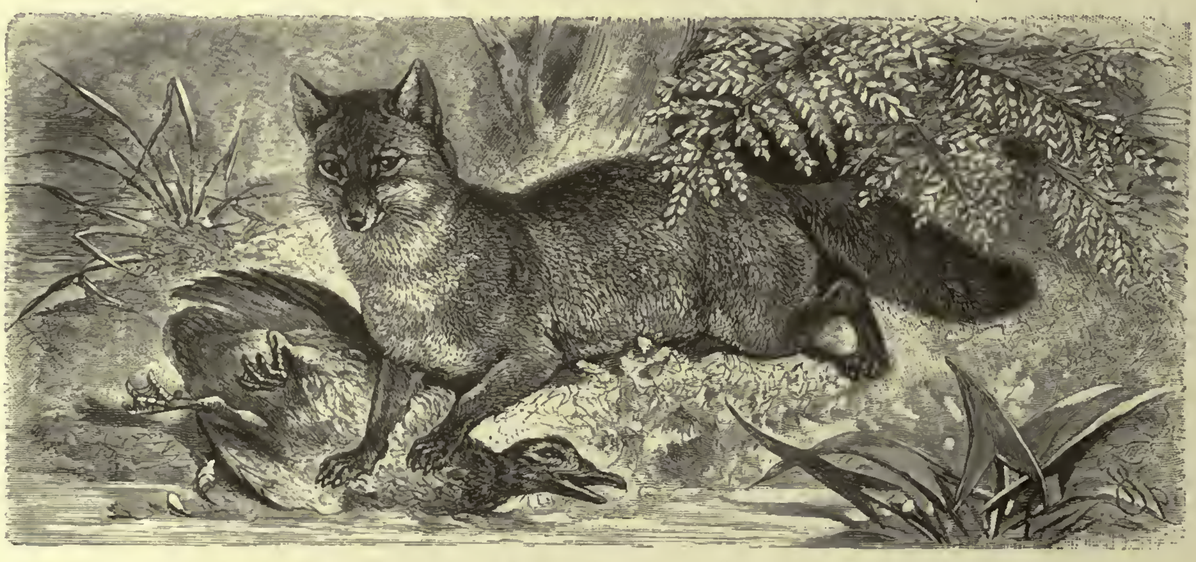


Fig. 63.—The Aguarachay (*Canis Azaræ*). page 145.

The fox never lives in troops. It hunts alone or at most by families. It digs holes for itself underground, and these are often very skilfully planned according to the locality, and always possess several means of exit or entry. The animal sleeps by day in a central chamber, in which also the female tends her young ones for a considerable period after birth. The fox, however, is very much addicted to taking possession by force or fraud of the holes dug by other animals, as, for example, by the badger or even by the rabbit among us, or by the bobak in the steppes of Russia. If it cannot drive out the legitimate owner, it appears to come to an understanding with him. That he does not seriously try to cope with the badger need excite no surprise, since the strength of the latter is much greater than his own. But it is much more difficult to believe those who tell us that they have found rabbits and foxes living together in the same burrows in perfect harmony.

Does Reynard answer to the reputation which the writers of fables have created for him? Yes and no. While exaggerating his intelligence, cunning, treachery, and hypocrisy, these fable-writers have at the same time underrated the qualities of those animals with which they bring him in contact. He certainly possesses in a high degree all the qualities demanded by the business of a sly thief, and even exhibits a certain good-humour or disposition to tease, while at the same time we know of many surprising instances of a strange simplicity on his part. When hunted it often manages to escape with remarkable adroitness from hounds and huntsmen in full cry. He resorts to all devices to attain his end. He exhibits cunning and audacity, rapidity of movement, patience, and an accurate knowledge of localities. His behaviour is certainly very different according as he feels himself in perfect security or dreads danger. By day he ventures out in quest of his prey if he has to dread neither dogs nor men, but he does not leave his hole before nightfall if his keen scent or acute hearing warns him that it might be the worse for him. He is an excellent runner and jumper, crawls like a snake noiselessly along the ground when he wants

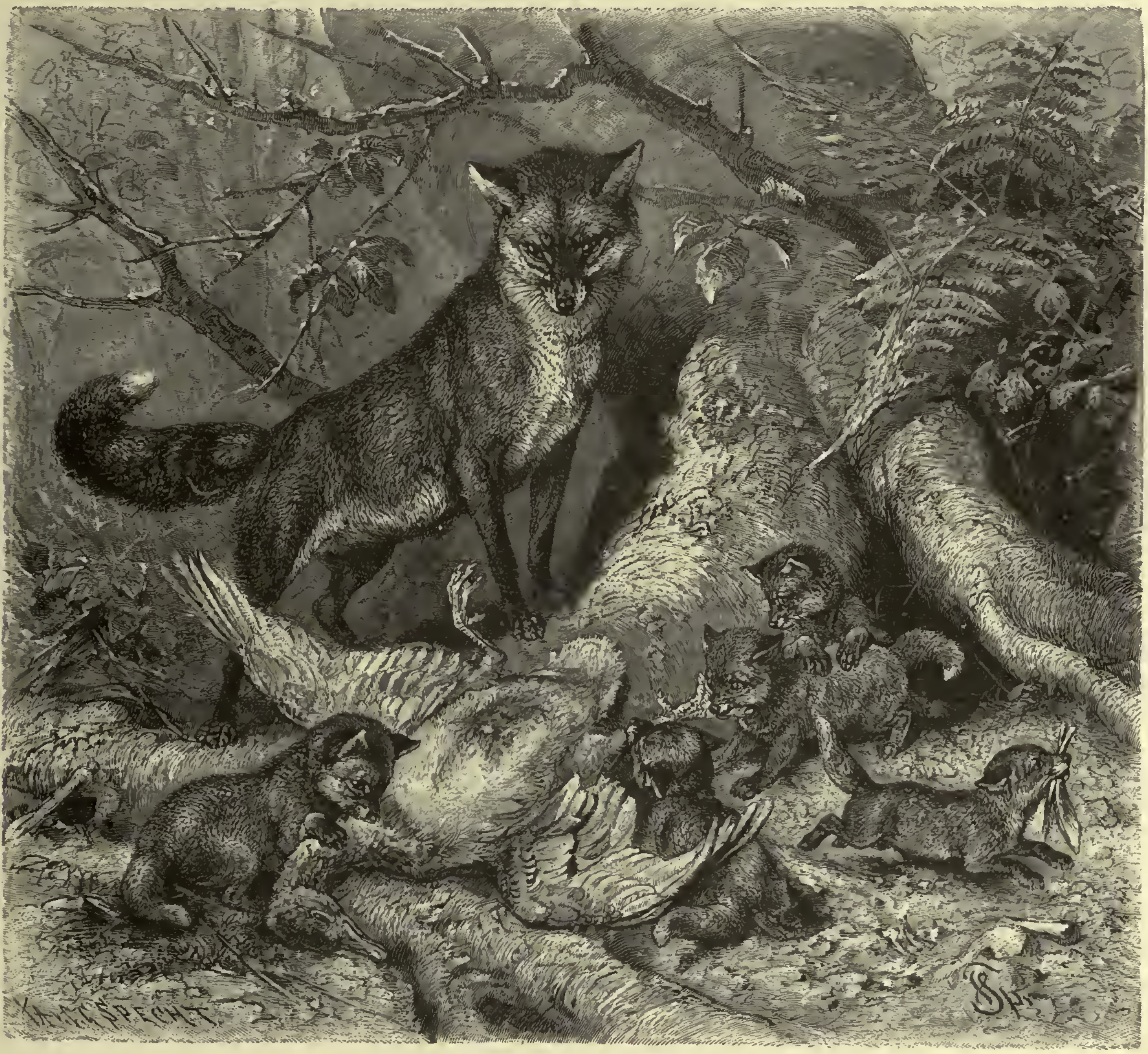


Fig. 64.—The Fox (*Canis vulpes*).

to approach his victim or to hide himself, and knows so well how to obliterate his trail that the best dogs are often at fault. Hunger seldom blinds him to danger, but when he has the opportunity he kills without mercy and far beyond his immediate needs.

In our civilized countries, in which the stronger carnivores are altogether wanting, the fox is certainly the deadliest enemy of all kinds of game, for he attacks even the young of the roebuck, without sparing other smaller creatures. The hunters pursue him all the more eagerly because he practises so many tricks upon them, and as in the case of the wolf all methods seem good that lead to his extinction.[1]

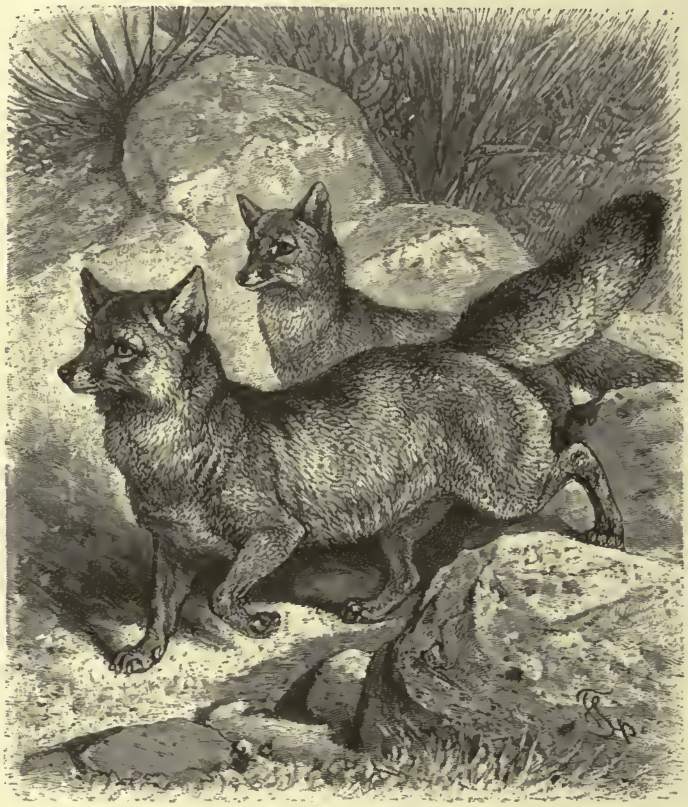


Fig. 65.—The Corsac (*Canis corsac*).

But if we are bound to acknowledge all these devastations which the fox commits in the poultry-yard, and must also place to his account the few bunches of grapes which, when they do not hang too high, he consumes for dessert, after he has regaled himself by night on a cock or a duck, yet it must also be admitted that in our country, at least, the fox lives chiefly on field-mice, of which he devours remarkable quantities. In spring, when the young ones have been weaned, the fox is glad to find larger prey, but these depredations among fowls, partridges, young hares, and so forth, usually last at most one or two months. All the rest of the year mice form his chief food, and then it scarcely happens except by accident, when a peculiarly favourable opportunity presents itself, that he snatches a bird or makes a feast on a young hare. The farmer who looks well after his fowls by day and at night shuts them up in poultry-yards inaccessible to the fox and watched into the bargain by a good dog, should consequently only rejoice at the services which Master Reynard renders him in ridding his fields of mice. Finally, when we consider that game undoubtedly does more harm than good to the agriculturist, we might draw the very unwelcome conclusion for lovers of the chase, that the fox is to be ranked with those animals which confer the greatest benefits on agriculture.

Foxes captured young have often been tamed and brought up along with dogs. But the strong disagreeable odour proceeding from the anal scent-gland, and their pitiful howling, are so unpleasant, that these experiments have always ultimately been abandoned.

The **Corsac** (*Canis corsac*), fig. 65, is a smaller fox, with rounder pupils and a shorter tail, which has adapted itself to life in the steppes and deserts of northern and central Asia. The extremely thick fur is red in summer, lighter and somewhat grayish in winter, the under-surface yellowish. A lighter patch above the eye reminds us of the markings of most badger-hounds. The corsac has a very different mode of life from that of the fox. He digs no hole for himself, sleeps where he can, often in the burrows of the bobak, and traverses wide stretches of the steppes, which he inhabits to the exclusion of the woods and mountains. He hunts everything which he is a match for, and even follows the swarms of locusts, of which he devours great numbers. His fur is highly esteemed in China, but scarcely enters into European trade.

---

[1] In Germany, to wit, not of course in England.—Tr.

On the island of Jan Mayen I became well acquainted with the **White or Arctic Fox** (*Canis lagopus*), fig. 66. As its name indicates, this pretty animal, which is much smaller than our fox, inhabits all Polar lands, and it is likewise found in the mountains of Norway, even beyond the Arctic Circle. The muzzle is shorter, and so also are the ears, than those of our fox. The tail is very bushy, and the claws of the two middle toes of the fore-feet project a good deal, and are very strong. The legs are very short, and the soles of the feet quite covered with hair. The animal is very remarkable on account of its change of colour according to the season. In summer the fur is grayish brown, with a violet or blue shimmer; in winter it becomes much thicker, and consists of a snow-white, short, warm down with longer hairs intermingled. Hence the terms blue fox and white fox are both applied to this animal. Since this alteration is only gradually accomplished many sorts of mixtures in the colours are to be seen, and moreover all Polar foxes are not subject to these half-yearly variations, so that one may meet with gray specimens in winter and white in summer. The fur is not greatly valued, since the hair does not remain long attached to the skin.

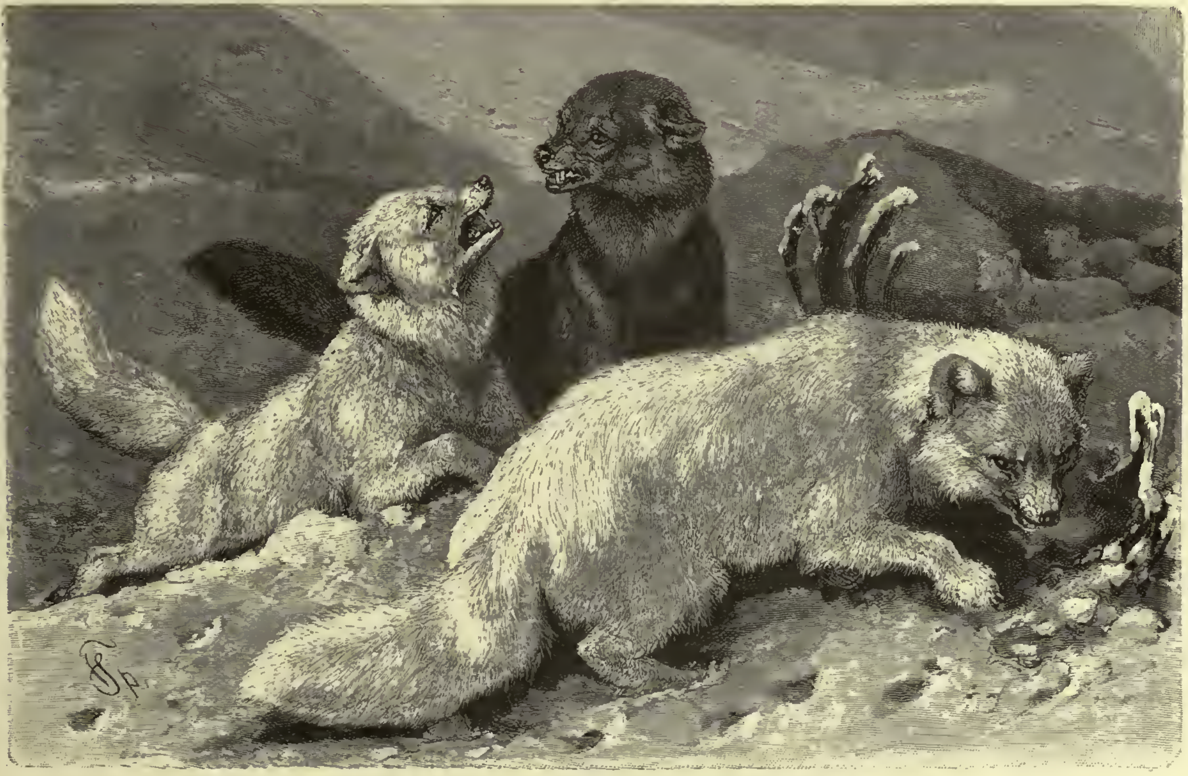


Fig. 66.—The White or Arctic Fox (*Canis lagopus*).

This animal, at once crafty, foolishly bold, and stupid, picks up a miserable subsistence by eating all it can find in the dreary wastes which it inhabits. All observers are agreed as to the rare mixture of cowardice, slyness, and boldness rising to the pitch of folly, which this fox exhibits. Usually very timid and cautious, at certain times it shuns no danger, and allows itself to be struck dead without making even an attempt at flight. On the island of Jan Mayen we have seen these foxes, though they had never before seen the face of man, flee away even when we were at a great distance, and afterwards fall upon an overcoat which had been left on the shore, and begin gnawing and devouring the greasy collar without allowing themselves to be driven away by the sailors pelting them with stones. Steller, who in the beginning of last century was compelled to remain a year on one of the islands of Behring's Strait, where his ship had been stranded, tells the most singular tales about these foxes. They stole everything in the huts, both edible and inedible; snatched from the shipwrecked party the bodies of the animals which they had just killed, removed the men's clothes and blankets while they were sleeping, dug up their dead in order to devour the corpses, and buried their booty with such skill that it was impossible for anyone to find it. All these acts of theft effected with such unbounded insolence had at last so enraged the shipwrecked mariners that they were not content with killing the foxes by the hundred, but tortured the hated beasts to death in the most cruel manner.

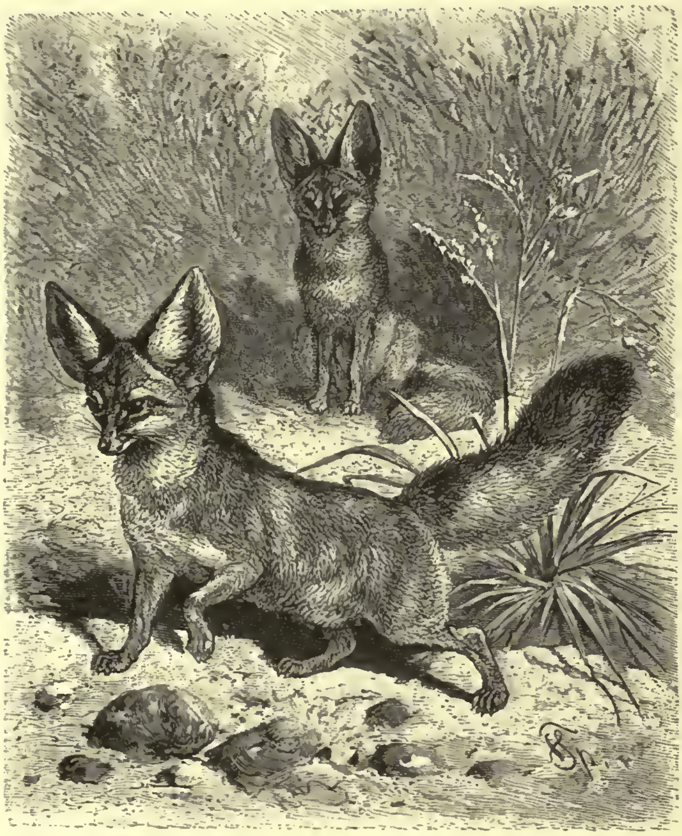


Fig. 67.—The Sahara Fox or Fennek (*Canis zerda*).

The Arctic fox indeed devours everything that a fox's stomach can digest; but its chief resource consists in all sorts of birds and waifs from the sea. The island of Jan Mayen, on which I have seen them in troops of from twelve to fifteen individuals, affords no other kind of food. It has neither plants nor other mammals, but has swarms of swimming and diving birds, which the foxes are very adroit in surprising—darting upon them and seizing them with a sudden bound. The nests of these birds—stormy petrels, auks, great northern divers, and gulls—escape from the depredations of these plunderers by the fact that they are built on the sides of cliffs which sink precipitously down and are inaccessible to every animal which cannot fly. There remains accordingly the refuse of the sea, the skeletons of whales, dolphins, seals killed on the ice, fish, crustaceans, and molluscs,—in short, all that can be cast upon the shore. That is manifestly their sole resource in winter, when they are exposed to long famines.

No attempts have ever been made to tame these Arctic foxes. They always remain wild and insensible to caresses. I brought with me some very young scarcely weaned specimens, which continued to live for a long while in the zoological gardens at Frankfort. Luckily our voyage from Iceland, where we bought them, did not last long; for I believe we could not have kept them much longer on board the ship, they so polluted everything with their abominable stench.

The smallest, but at the same time the most elegant of all the Canida, is the **Sahara Fox**, the Fennek of the Arabs (*Canis zerda*), fig. 67. Its body measures only 18 inches from the tip of the snout to the root of the tail; the tail measures about 8 inches. The head is pretty broad and almost spherical, the muzzle narrow, pointed, and furnished with long whiskers. The body is slender, the tail bushy, the limbs short and very thin but well formed, the eyes large with oval pupils. But what chiefly distinguishes the fennek from other animals of its kind are the very large ears in the form of paper-cornets, these ears being in fact longer than the head, internally covered with long silky hairs and almost constantly in motion.

Like all inhabitants of the desert the fennek has the colour of the ground of these naked wastes: it is grayish-yellow on the back, rather lighter below. The very thick, fine, silky fur is made still thicker in winter by the addition of a warm covering of down.

The fennek is nocturnal in its habits. It digs very artistic holes for itself, and these it prefers to form among the tufts of alfa-grass. When pursued it escapes from sight by burrowing in the sand with lightning-like rapidity. Its hearing and its smell are alike keen; the slightest noise arrests its attention, and when it has once found a scent it does not easily lose it. Its food consists chiefly of birds, which it surprises in their roosts noiselessly and with admirable skill. Courageous and fierce, this little creature attacks even the tufted fowls of the desert. If it finds nothing better it tries to catch even the agile and wary jerboas, and despises neither lizards nor the larger beetles nor locusts. The dates fallen from the palm-trees are a dainty greatly relished. It appears not to care about carrion, and since it keeps away from settled places and the encampments of the nomads it is scarcely pursued at all. The Arabs who come in contact with Europeans are well aware of the value which the latter place upon these amiable, gentle, and elegant little creatures. In Biskra, for example, fenneks are always offered to travellers for sale, and they readily become attached to their masters and eagerly respond to their caresses after they have undergone hard treatment and all sorts of privations at the hands of the Arabs. The fennek is fed just like a little dog; but it can scarcely stand the climate of Central Europe, always suffering from frost. Its plaintive sighing voice is like that of a little child.

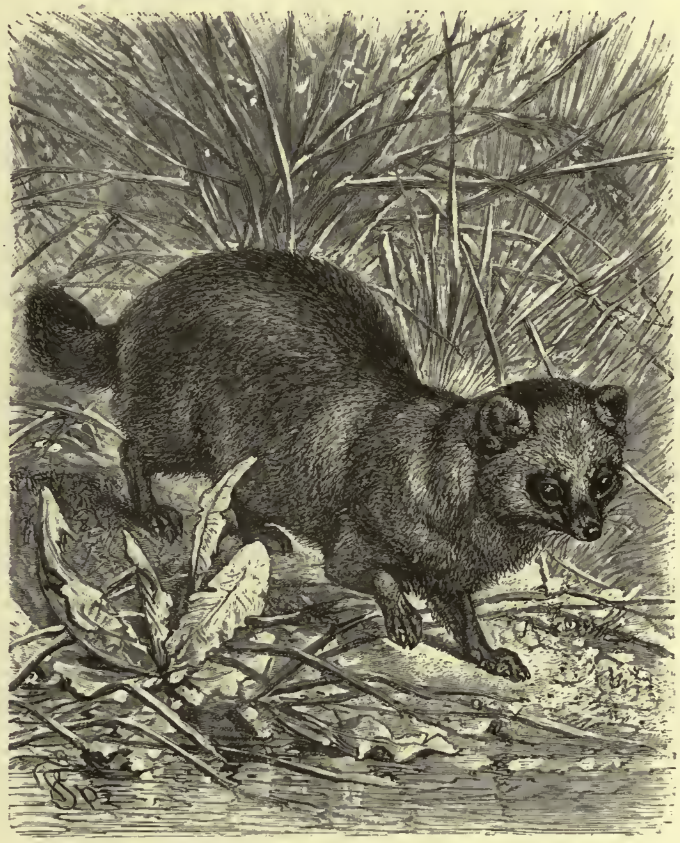


Fig. 68.—The Viverra Dog or Tanuki (*Nyctereutes viverrinus*).

A member of the Canida very different in form is the **Viverra Dog** (*Nyctereutes viverrinus*), fig. 68, the Tanuki of the Japanese, which inhabits the whole of eastern and middle Asia. The thick body supported by short legs, the very short rounded ears, and the pointed snout give the animal a good deal of resemblance to the Viverrida; while the short rounded tail and the fur covered with long disordered hairs remind us of the badger. The general colour is dark brown, the head and sides of the neck brighter, yellowish, the parts round the eyes and the ridge of the nose almost white. The dentition is altogether like that of the dogs; the tubercled teeth are well developed, and two of the premolars in the upper jaw disappear in older individuals.

This animal sleeps by day in the grass or in bushes, and hunts by night after the manner of foxes. It seeks especially for mice and fish, which it is very expert in catching; but it also eats fruits of all kinds, and is said to be altogether very voracious. In northern lands it has a short winter-sleep, most frequently in the deserted hole of a fox. The creature is easily tamed, but little more can be said about it.

The **Long-eared Fox** of South Africa, the jackal-gna of the colonists (*Otocyon caffer* (*megalotis*)), fig. 69, forms a separate genus on account of its remarkable dentition. It has an unusual number of tubercled teeth; in the upper jaw two, and in the lower jaw one more than the dogs, which brings the total number of the teeth up to 48.

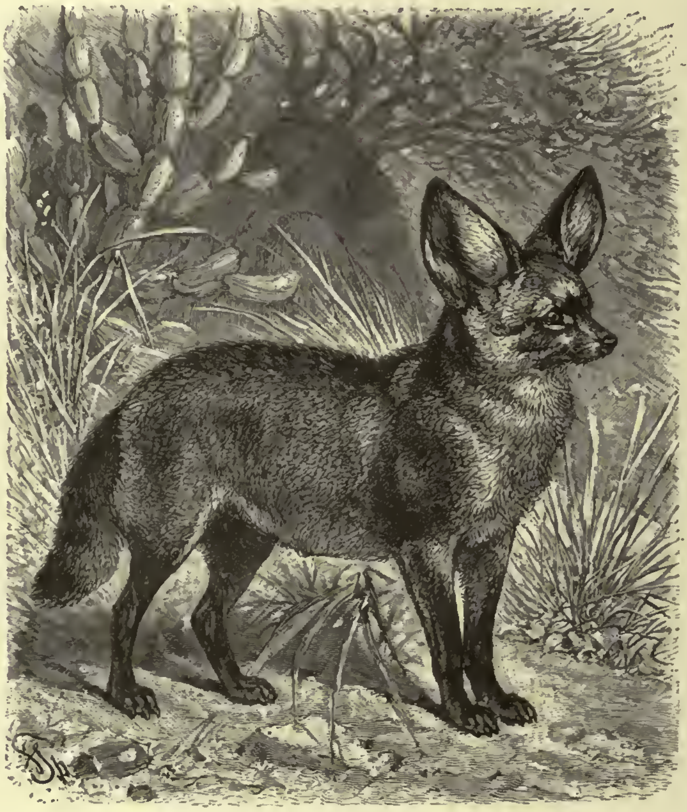


Fig. 69.—The Long-eared Fox (*Otocyon caffer*).

The form of the body is that of a jackal, with pretty long legs, pointed snout, thick head, and two enormous ears, like those of the fennek. The body attains the length of 2 feet, the very bushy tail about 1 foot. The general colour of the fur is grayish-yellow, while the ears, legs, and tail are dark-brown.

The long-eared fox inhabits the steppes occupied by scattered underwood to the north of the Orange River, and advances as far as the Zambesi. It conceals itself by day and hunts at night, making pitiful howls the while. Its food consists of small animals, and especially of locusts, the swarms of which it follows in their migrations.

A separate genus must also be formed for the **Cape Hunting-dog** (*Lycaon pictus*), fig. 70, of South Africa, where it is also known as the wild dog. This animal has, in common with the hyænas, four toes on all four feet, and also the large anal scent-glands, which diffuse a penetrating odour. But the resemblance to the hyænas, to which the animal owes the name of hyæna-dog sometimes applied to it, is confined to these peculiarities, and with respect to all other characters, as well as its mode of life, it is a savage wolf with long legs, round pupils, and large, almost naked ears, which give it some resemblance to the former species. The Cape hunting-dog is one of the most variegated of all mammals. Broad black, yellow-ochre, and white patches are scattered over its body in so irregular a manner that no two animals can be found similarly marked, and even the patches on the two sides of the same individual exhibit no symmetrical arrangement.

Having a very keen scent, which, as the hunters maintain, surpasses that of the best blood-hounds, the Cape hunting-dog hunts in troops of twelve or thirteen individuals the large herbivora of its native land—the antelopes, gnus, and even the terrible Cape buffaloes. The narratives of travellers are full of admiration for these savage animals, which, overwhelming each other in the fury of their career, scour the plains in pursuit of the antelopes, and pay no heed to the wounds which the buffalo inflicts on them with his horns and hoofs. After striking down their prey they are said to devour, not only the object of their pursuit, but also those of their comrades which have fallen on the field of battle. They devastate the flocks of the colonists when these are not well watched, and even attack man.

Tame Cape hunting-dogs have been seen, and it is recorded that certain tribes in the interior of Africa train them for hunting, catching them young in the holes which the mothers dig for their cubs. Their introduction into Europe for employment in great hunting parties has even been recommended. The horrible stench which these animals diffuse, as well as their inability to stand the severity of our climate, will, in our opinion, place insuperable obstacles in the way of the accomplishment of this acclimatization, which is besides altogether undesirable.

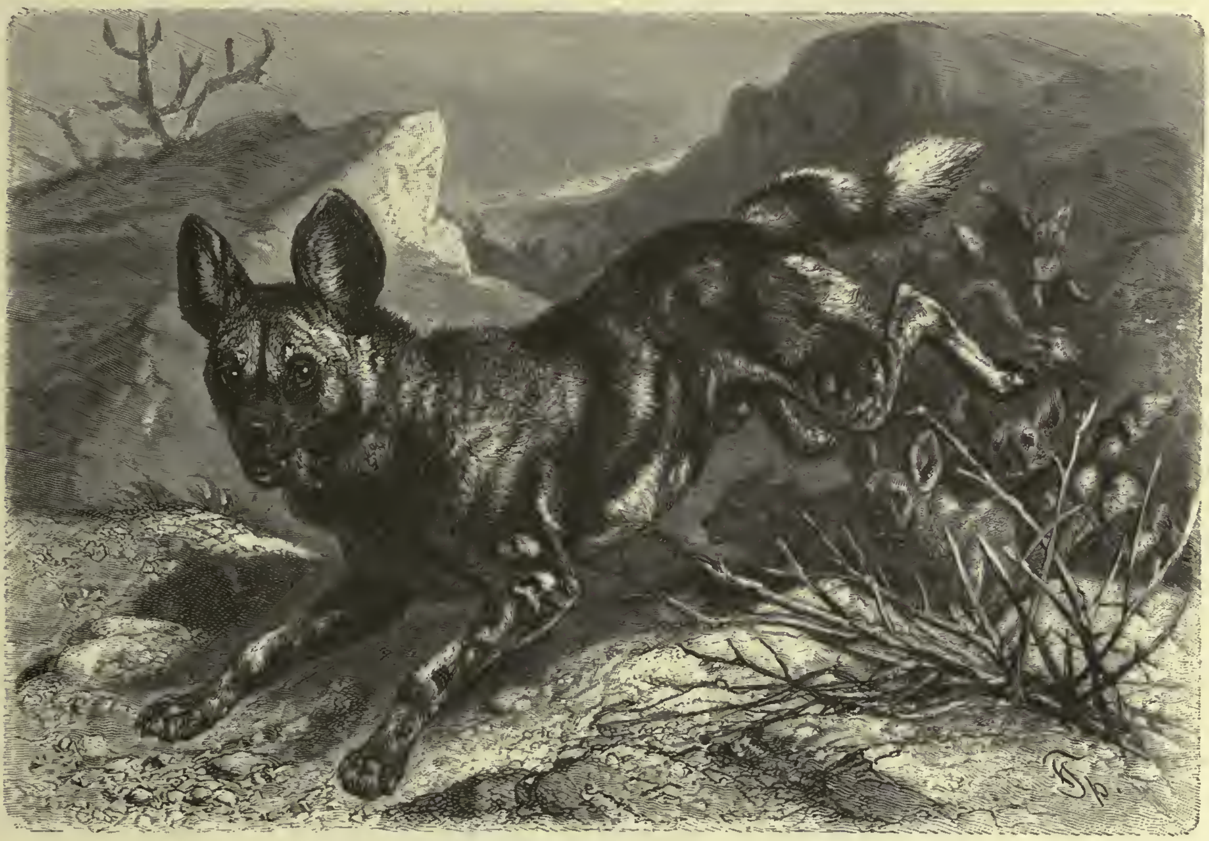


Fig. 70.—The Cape Hunting-dog or Wild Dog (*Lycaon pictus*).

"Among the flocks and herds [of South Africa] there is no animal whose ravages are more dreaded than those of the wild dog. Fortunately their visits are rare, for I have known as many as fifty or sixty sheep missing after one, though, of course, not a third of that number had been killed by them; and so daring are they that I have seen them dash into a herd of cattle feeding not a hundred yards from the house, and drive out a beast, disappear over a rise in the ground with it, and kill it and pick its bones before we could get the saddles on our horses and follow them. It is a marvellous sight to see a pack of them hunting, drawing cover after cover, their sharp bell-like note ringing through the air, while a few of the fastest of their number take up their stations along the expected line of the run—the wind, the nature of the ground, and the habits of the game all taken into consideration with the most wonderful skill; and then to see them after they have found, going at their long unswerving gallop, so close together that a sheet might cover them, while those who had been stationed, or had stationed themselves, it is hard to say which, drop in one by one as they find themselves unable to make the running any longer; and the chase, generally a gnu or a water-antelope, pressed first by one and then another, though it may distance the pack for a while, soon comes back to it, and is in the end almost invariably run into. The only thing to which I can compare these animals, and their instinct, as people call it, is a pack of hounds hunted and whipped in to by members of their own body, and combining in one human reason and brute cunning and power."—Drummond, *The Large Game of South and South-east Africa.*

THE HYÆNAS

(HYÆNIDA.)

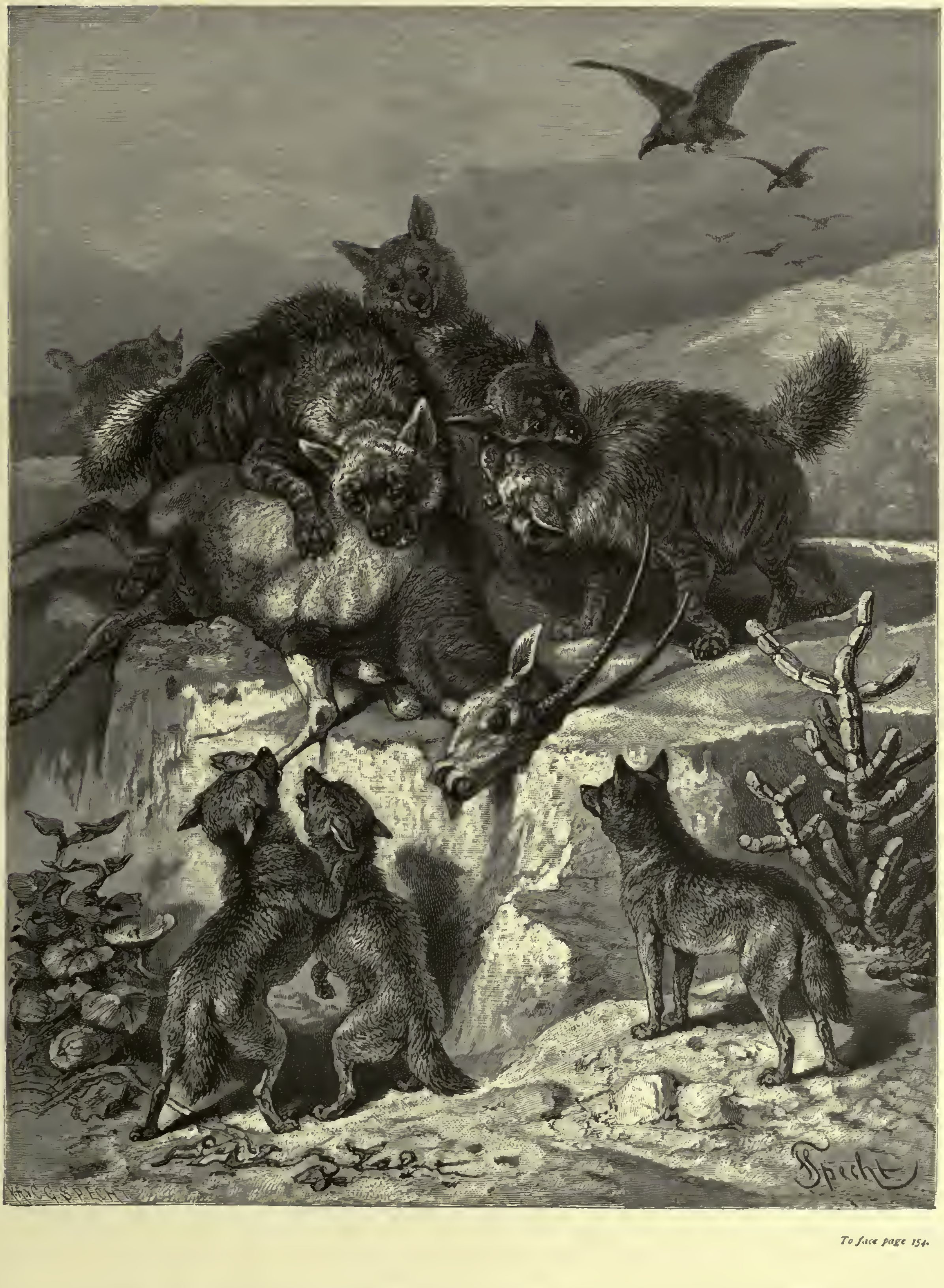
Digitigrade carnivores, with powerful body decreasing in size from before backwards; mostly with four toes on all four feet, and at most 34 teeth.

The hyænas form only a small group among the Carnivora of the present day, but played a more important rôle, especially during the earlier part of the Quaternary epoch. They are animals inferior in size only to the large felines and bears, and are distinguished at the first glance by the great disproportion between their very strong but somewhat crooked fore-limbs and their weak hinder quarters.

The head is massive, broad behind, the muzzle short, the ears pretty large and pointed, the eyes placed at the side, very prominent and with round pupils, the nose short and blunt, the tail short but bushy; the fore-limbs are longer than the hind-limbs, but are always curved inwards. In the true hyænas all the feet have four toes armed with strong non-retractile claws, while the abnormal genus composed of the earth-wolves (Proteles) has five toes on the fore-feet like dogs. The fur is very long and coarse, but not very thick; longer hairs form a mane on the nape of the neck and the front part of the back. All hyænas have a rather large gland on each side of the anus, and from these glands there proceeds a strong disagreeable odour.

The skull of the hyænas somewhat resembles that of the Felidæ in the round form and comparatively small capacity of the brain-case, in the great development of the ridges for the attachment of the muscles, in the wide sweep of the zygomatic arches, and in the shortness and strength of the jaws. The processes of the neck vertebræ are unusually well developed. The rest of the skeleton approaches that of the Canidæ in structure.

The dentition is very remarkable. The strong middle incisors have chisel-shaped crowns mostly ground down by use, while the outermost incisors are conical and similar in form to the strong, almost straight, and not very sharp canines. The three premolars which follow the canines in each jaw are single-cusped, the first too low, the third very large and strong. Next comes in each half of each jaw an enormous carnassial tooth. Those in the upper jaw have each two broad sharp lobes which form an angle at their point of union, so that the tooth, supported as it is by a strong internal heel or process, when seen from above presents the form of a half-moon. In the upper jaw this formidable carnassial is followed by a small tubercled tooth, which is wanting in the lower jaw. The carnassial of the upper jaw is present even in the milk dentition, while that of the lower jaw, on the other hand, first appears in the permanent set of teeth. In each jaw



To face page 154.

PLATE VII. — STRIPED HYÆNAS (*Hyæna striata*) AND JACKALS (*Canis aureus*).

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

accordingly there is only one molar; all the others are premolars.

The milk dentition is not less remarkable. Besides the incisors and the canines there are in the upper jaw four premolars, a small front one which is never changed, a two-lobed one with two roots, which disappears and is succeeded by a conical tooth, a third, forming the carnassial, with three lobes and a heel, which is ultimately replaced by the third conical tooth of the permanent dentition, and a fourth small one, the place of which is ultimately taken by the permanent carnassial. In the lower jaw are four premolars, the first of which is small and is never replaced after it has been shed, while the other three are replaced, a carnassial being at the same time added in the permanent dentition. Milk dentition: $\frac{3 \cdot 1 \cdot 4 \cdot 0}{3 \cdot 1 \cdot 4 \cdot 0} = 32$. Permanent dentition: $\frac{3 \cdot 1 \cdot 4 \cdot 1}{3 \cdot 1 \cdot 3 \cdot 1} = 34$. This is one of the rare cases in which the permanent dentition exhibits great changes in form as compared with the milk dentition, yet with only a slight increase in the number of the teeth.

The structure of the skull and the nature of the dentition indicate strength of jaw, and the hyæna manifests this strength at every meal. It crunches into fragments bones which resist the jaws of the lion, and seems to swallow the splinters with a peculiar relish. In old hyænas the teeth are generally found to be much worn away, and often to such a degree that the crowns have almost disappeared, and the cavities of the teeth are exposed.

All hyænas are nocturnal animals, which pass the day in solitude in caves and grottoes, which they quit at night in order to hunt their prey in bands. They call one another together by making a diabolical concert which lasts till they find some booty, which they then proceed to devour in perfect silence, though frequently not without some savage quarrelling and fighting.

The hyæna is specially a carrion-eater. With an apparently limping and waggling gait it trots about in search of food, and cannot long keep up a more rapid rate of progression. It is far from having the keenness of sense which distinguishes the Canidæ. The Arabs even maintain that the hyæna finds little success in its search for food unless it is led by the jackal. And it is indeed a fact that in Algeria at least the jackal is always heard first at the beginning of the night, and that it is not till later that the voice of the hyæna is joined to the miserable yelping of his cousin, and that jackals are always certain to be seen when hyænas announce their presence. Yet this comradeship is not carried so far on the side of the hyæna that it would allow the jackal to share in its feasts. As long as it is unsatisfied it drives away the jackal by force, and the latter is compelled, in spite of its pitiful howling, to wait till it can pick up the crumbs from its master's table.

Voracious and cowardly the hyæna roams round the villages of the settled population and the camps of the nomads, and follows the caravans in order to make its disgusting meals on animals that have died from thirst and exhaustion. Nothing is more repulsive than such a meal. The stench of the carrion attracts the hyæna by night as it does the vulture by day; and the first thing which the former does on finding a carcass is to tear open the abdomen and wallow with its head and fore-feet in the putrefying entrails. It pays no respect to graveyards, but digs up dead bodies if the grave is not too deep.

The cowardliness of the hyæna has become proverbial among the natives. According to their account these disgusting brutes never attack animals which can make a serious resistance. The large Canidæ regularly make them take to flight, and the larger antelopes, horses, oxen, boars, and even asses defend themselves against them with success. If we only considered the terrible weapons found in its jaws, which are only surpassed by those of the Felidæ, we should conjecture that the hyæna must be a ferocious beast of prey dangerous even to man. But that is not the case. The spotted hyæna will at most seize on little children when awake, though it may perhaps attack adult persons found sleeping outside of the houses or the tents. But the flocks of sheep and goats suffer greatly from the ravages of hyænas, when they are not protected by courageous and watchful dogs.

The natives do not hunt the hyæna, but merely kill it when they can. In their opinion the hyæna is so filthy an animal that it would only pollute the weapon with which it was wounded. It is caught in snares, pits, or other sorts of traps. Sometimes it is poisoned, sometimes caught alive. Only the European colonists and travellers honour it with rifle or musket shots. In North Africa the Arabs, provided only with a piece of carpet, boldly enter the cave of a hyæna, which allows itself to be driven back hissing like a cat and snarling. When the animal has thus been forced back to the inmost recess of the cave the intruder throws the carpet over its head, and then, regardless of the fury with which it attempts to bite and scratch, falls upon the animal and binds the carpet firmly round its head, ties its legs with a cord and drags it into the camp, where the women and children stone the animal to death.

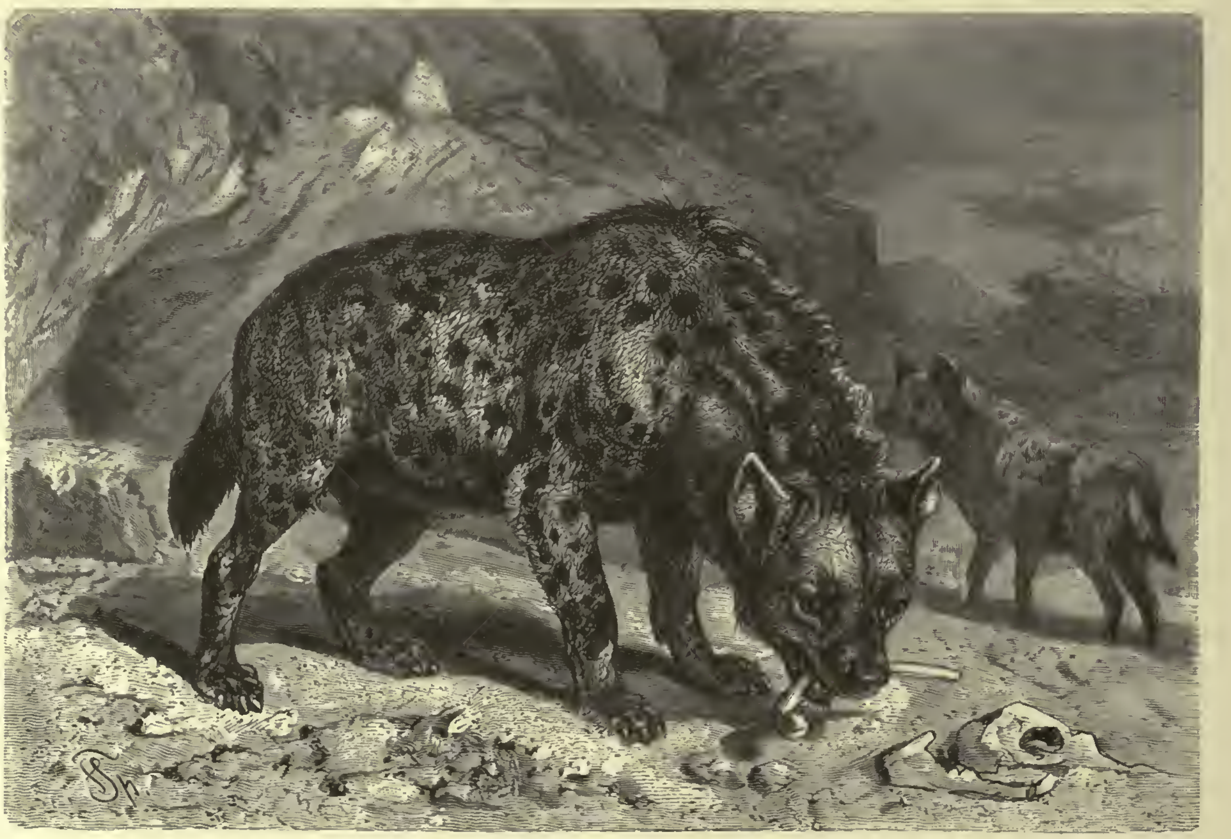


Fig. 71.—The Spotted Hyæna (*Hyæna crocuta*).

In some secure retreat the female hyæna brings forth at a birth from three to seven blind and shapeless cubs, which she watches over tenderly, and even defends with courage until they can shift for themselves.

They are easily tamed and trained when young. The captive hyænas are obedient, but never get so sincerely attached to their masters as the large felines sometimes do. Their stench, their disagreeable disposition, and their hideousness cause these efforts at taming them to be confined to menageries.

The **Striped Hyæna** (*Hyæna striata*),—of which there is a full-page illustration, Plate VII., representing a troop in the act of falling on the carcass of an antelope, while the jackals respectfully await their share,—is that form which has the widest geographical distribution. It is found in all the temperate and warm parts of Africa and Asia, from the shores of the Atlantic to those of the Pacific. Formerly it swarmed in Algeria; but in spite of its inclination to haunt the vicinity of human dwellings it is gradually retreating, especially before the European colonists, who are not restrained in their attacks upon this animal by the superstitions which the Arabs entertain with regard to it. The large black transverse stripes on the reddish-yellow fur at once distinguish it from the allied species.

The tubercled tooth in the upper jaw is quite rudimentary, and often disappears altogether in the adult animal. Notwithstanding this mark of a carnivorous dentition, and in spite of its comparatively large size, this species is the most cowardly of all.

The tubercled tooth persists in those species which are peculiar to South Africa. In the **Spotted Hyæna** (*Hyæna crocuta*), fig. 71, which formerly used even to visit the streets of Cape Town, brown spots are irregularly distributed over the reddish-yellow fur. In certain districts this animal is still dreaded as a beast of prey, since it is not disinclined to pursue living game. In the **Brown Hyæna** (*H. brunnea*) the hair on the back is of a uniform brown colour and not very stiff, and ultimately becomes very long, so as to fall down over the body and form a sort of mane.

The brown hyæna mostly roams about the sea-shore, and feeds on refuse cast up by the sea; but it also attacks flocks of domestic animals.

All these hyænas have the same noisy nocturnal mode of life, and the same disgusting habits. But while the other two species utter broken howls, abruptly changing from an unsteady bass to a high-pitched tenor, the spotted hyæna expresses its various feelings by a sort of yelping, extremely penetrating, diabolical laughter, a genuine laugh of despair at once terrible and comic. This form is not so easily tamed as the striped species. It is said to be more stupid than the latter, but the differences in respect of mental qualities cannot be great. Dulness of sense and voracity are the most prominent attributes of both.

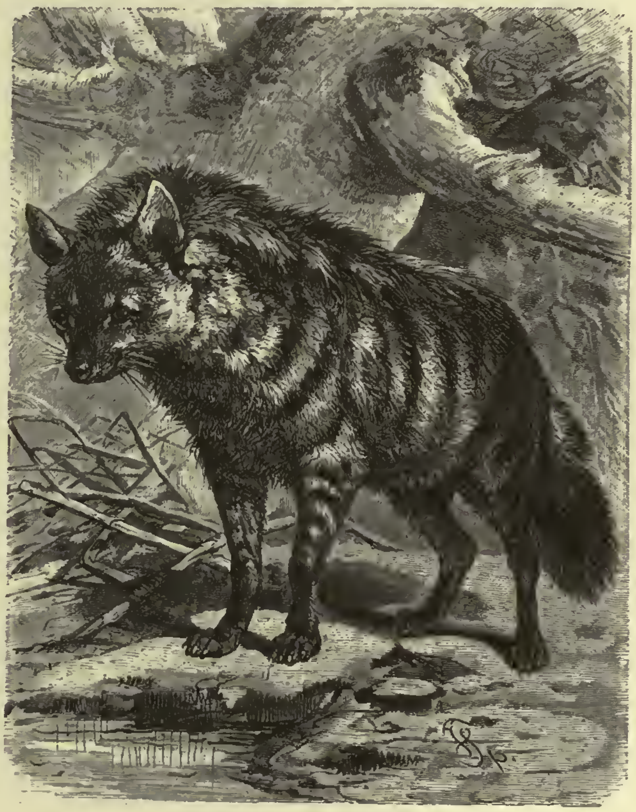


Fig. 72.—The Earth-wolf or Aardwolf (*Proteles Lalandii*).

A very abnormal genus is formed by an animal which is moreover rather rare, the **Earth-wolf,** or Aardwolf of the Dutch settlers at the Cape, where it is to be found. Its scientific name is *Proteles Lalandii*, fig. 72. Judging from its bearing and general aspect one might regard the animal as a rather small striped hyæna, but its fore-feet are five-toed like those of the Canidæ, and the stripes with which it is marked are further apart than in the hyæna, which it otherwise resembles externally. And, after all, the resemblance is only external, and disappears on an examination of the skull and dentition.

The ridges for the attachment of the muscles are very slightly developed, and both premolars and molars few in number and very rudimentary. The incisors and canines, however, still preserve the hyæna type. The molars and premolars are nothing but small sharp lancet-shaped blades, and are placed so far apart that they cannot fit into one another when the mouth is closed. They are very apt to fall out. In the specimens of the earth-wolf best furnished in this respect there are in all 30 teeth, four molars above, three below, so similar in form that no distinction could be pointed out between true molars and premolars. Singularly enough, however, these distinctions are found in the milk dentition, in which there is a carnassial tooth. In this way it is proved that this form of dentition is the result of a process of degradation whereby the animal has got rid of a portion of the carnivorous characters which belonged to its ancestors.

The earth-wolf lives in underground holes, which it digs out very rapidly. It is said to feed chiefly on lambs, and to be very fond of the fat tails of sheep. Possibly this may be so, but if we may judge from the dentition we should expect it to live chiefly on prey which it can snap up and swallow whole—small lizards, locusts, and insects of all sorts. Scarcely anything is known about its mode of life, except that it is nocturnal in its habits, and, as already intimated, has its dwelling underground.

THE CAT TRIBE

(FELIDA).

Digitigrade carnivores, mostly with retractile claws and never more than 30 teeth.

The Felida are without doubt the typical carnivores. They combine an undeniable grace with extraordinary strength, an innate ferocity with the most gently caressing disposition. The flexibility of their limbs, the adroitness which they show in their games and their serious battles, the untamable spirit with which they fight, the treacherous caressing ways which they exhibit on favourable opportunities, the mode in which they keep their fur clean—that fur which is often so richly adorned; all these qualities combined would certainly have given these animals precedence as domestic animals over the Canida, to which they are certainly equal in point of intelligence, if their independent character, their love of freedom and hatred of restraint, did not throw obstacles in the way. The cat is attached to its master, loves him, but does not become his slave like the dog. It always, even in the most humble position, preserves a remnant of its personal pride. Even in the worst conditions the Felida always remain free from disagreeable odours, and never diffuse those ill-smelling effluvia of which the dog-tribe and the hyænas are so lavish.

The head in the Felida is in general not very large, but is always quite distinct from the strong thick neck. It is round, almost spherical, the profile of the brow mostly curved, seldom flat as in the lion; the muzzle blunt, the lips thick, with strong tactile hairs forming whiskers or moustaches; the ears small, hairy, and very mobile; the eyes large, separated by a pretty broad ridge of the nose, the pupils mostly in the form of a vertical slit, though in certain cases round. The body is powerful, often pretty long, the tail sometimes long, sometimes short; the legs strong, muscular, seldom long; the paws broad, and with five toes in front, four behind. The first digit of the fore-foot is shortened, and does not touch the earth. The claws of the Felida are perhaps more dangerous weapons than their teeth. Usually the members of this group slink quietly about on velvety feet, the sickle-shaped claws, sharp as razors, withdrawn in the sheaths formed by folds of the skin on the back of the paws, being held back in that position by strong elastic ligaments. In walking and in playing the claws are not protruded, and thus escape being worn away, and remain always sharply cutting. But when in action the claws are exserted by the powerful contraction of the flexor muscles of the toes effecting a rotatory movement of the last joint, to which the claws are attached. As soon as the contraction of the muscles ceases the elastic ligaments bring them back to their normal position. The cat can thus stretch out its claws at will; as soon as this exertion of the will comes to an end they dart back into their sheaths as if by the action of a spring. The cheetahs or hunting-leopards, which have long legs like the Canida, do not possess this structure of the toes.

The strong and formidable dentition varies within only very narrow limits. The incisors are small, close-set, sharp, and adapted for gnawing bones. The frequently enormous canines are curved, pointed, sharp on the hinder edge, and grooved on the outer side with longitudinal furrows. In the upper jaw there are three premolars, the first of which, small and conical, disappears altogether in the lynxes; the second, sharp and laterally compressed, has a sharp median blade-like cusp; and the third, the carnassial, with two broad sharp cutting lobes, has a small internal rounded heel. Immediately behind this carnassial there is a very small tubercled tooth, the only true molar in the upper jaw. In the lower jaw are two premolars with sharp median cusps, and a carnassial with two sharp lobes but without a heel, this carnassial being a true permanent molar. The upper tubercled tooth and the lower carnassial are absent in the milk dentition, in which we find the same arrangement as in that of the hyænas, namely, that the last premolar both in the upper and the lower jaw plays the part of a carnassial. This form of tooth thus becomes in the present as in the previous families shifted in position in the permanent dentition, in which it occupies the next place behind.

The dental formula is thus as follows:—

Milk dentition: $\frac{3 \cdot 1 \cdot 3 \cdot 0}{3 \cdot 1 \cdot 2 \cdot 0} = 26.$

Permanent dentition: $\frac{3 \cdot 1 \cdot 3 \cdot 1}{3 \cdot 1 \cdot 2 \cdot 1} = 30.$

The longitudinal or sagittal crest of the skull is not so prominent as in the hyænas and the Canida, but the ridges at the back of the skull are very highly developed; the very short-levered jaws, accordingly, possess, with an equal bulk of masticatory muscles, much greater strength than longer jaws, such, for example, as those possessed by the Canida. The muscles of mastication are indeed remarkably powerful, a fact to which the wide sweep of the zygomatic arches in this case also bears testimony.

Among the anatomical features we mention only the tongue, which is covered with horny warts with points directed backwards, and acts like a rasp. The Felida can draw blood by licking. The females have eight teats, which lie in pairs both on the breast and the abdomen.

Distributed over the whole earth except Australia, Madagascar, and the Antilles, the Felida lead almost everywhere the same nocturnal life. They hunt especially after living prey. They are greatly assisted in the chase by the acuteness of their hearing and their sight, and their extraordinarily changeable pupils adapt themselves in the most striking manner to the quantity of light that reaches them. The sense of touch is very highly developed in the hairs of the whiskers;

the eyes, which gleam by night like carbuncles, do not see very far, but are wonderfully adapted to recognize objects in the immediate neighbourhood in the darkness of night. The slightest noise arrests the attention of these animals, which never err as to the direction and place of origin of the sound. The slightest movement of an object excites in them the desire to pounce down upon it; motionless objects are not heeded.

They combine an astonishing flexibility with massive strength, suddenness of attack with infinite patience. With the exception of some large species, such as the tiger and lion, all the Felida with retractile claws are capital climbers. Many lie in wait for their prey, crouching close down on the branches of trees. Good runners in case of need, they yet prefer to attack by cunning rather than in open battle, to take their victim by surprise rather than to overpower him by superior force. They creep and crawl noiselessly up to the object of their pursuit, sharply watching all his movements, remain motionless when their destined prey shows any uneasiness, and again creep forwards when his fears seem to be set at rest. They make use of all the advantages of the ground like skilled hunters, concealing themselves as much as they can, until at last, when they have arrived within a sufficient distance, they overwhelm the animal with a sudden mighty spring, knock it down with a single stroke of their paw, and then tear it to pieces with their claws and teeth. Only when urged by the keenest pangs of hunger do they follow an animal which they have missed at the first bound. Usually they turn back with a shamefaced look and angry growls. But when their leap is successful, and they have struck their victim in the side, as is most commonly the case, or on the nape of the neck, and have rendered it defenceless by a few good bites, then begins an undignified scene—the victor plays with his victim, lets it stand up again and take a few tottering steps, then darts upon it anew, and shows by the motions of its tail, by its delighted purring, what pleasure it finds in the useless efforts of its panting and bleeding prey, as it vainly endeavours to escape from death. At last the cruelly murdered animal has breathed its last with convulsive spasms. In most cases the victor then seizes it in its teeth and carries or drags it to some secure retreat, where he devours it. It is in so doing that the extraordinary strength of these ravagers is most frequently displayed. A lion has been seen to leap over high hedges carrying an ox in its jaws.

The Felida do not bury their stores as the Canida do, and they eat carrion only in cases of dire necessity, when they have suffered long from want of food. But although they prefer a freshly killed victim, yet they will return for one or two nights to their prey when it has been too much for one meal.

The nature of the prey is in proportion to the strength of the ravager. The large Felida attack the large ruminants; the small species are content with mice, and even with lizards and locusts. In general the Felida avoid as much as possible encounters with antagonists which might vanquish them; they never become bold till they are urged by necessity. There are, nevertheless, accounts of battles for life or death with opponents whose strength or watchfulness the assailant had under-estimated, with competitors for some particular prey, or with rivals for the favour of some female in the season of heat. Towards man the large species behave in very different ways. They shun him when they have made acquaintance with fire-arms and when they come across him accidentally by day, for in general the Felida show little courage in the daytime. But lions, tigers, jaguars, and panthers have the reputation of preferring human flesh when once they have tasted it. Old males of these species are very apt to be "man-eaters." It may be surmised that this preference for human flesh is most pronounced in those places in which the animals have learned by experience that the attack upon an unarmed man is no very dangerous affair.

The Felida hunt alone or in pairs, never in troops. Males and females frequently combine their efforts when they have young ones, but these unions do not last, and for the greater part of the year Felida of both sexes remain solitary.

The Felida, and especially the wild species, are far from being so prolific as the Canida. Among the wild species two or three young ones at a birth appears to be the average.

The females seem to manifest a peculiar tenderness for their offspring, and to watch over them with assiduous care. While suckling they leave their lair only during the short intervals in which they are engaged in hunting. Constantly occupied with licking and cleaning her unruly cubs, and watching over their sports, the mother patiently allows herself to be ill-used by them in all sorts of ways. In defending them against enemies she will risk her own life fearlessly. There is no more terrible creature than the lioness robbed of her cubs during her absence. She follows the track of the robber for immense distances, uttering pitiful howls, and if she overtakes the object of her pursuit attacks him with furious rage. Should she find her offspring slaughtered she makes known her loss with a heart-rending cry. The maternal affection of the Felida is so strong that they adopt the sucklings of other species when their own have been ravished from them.

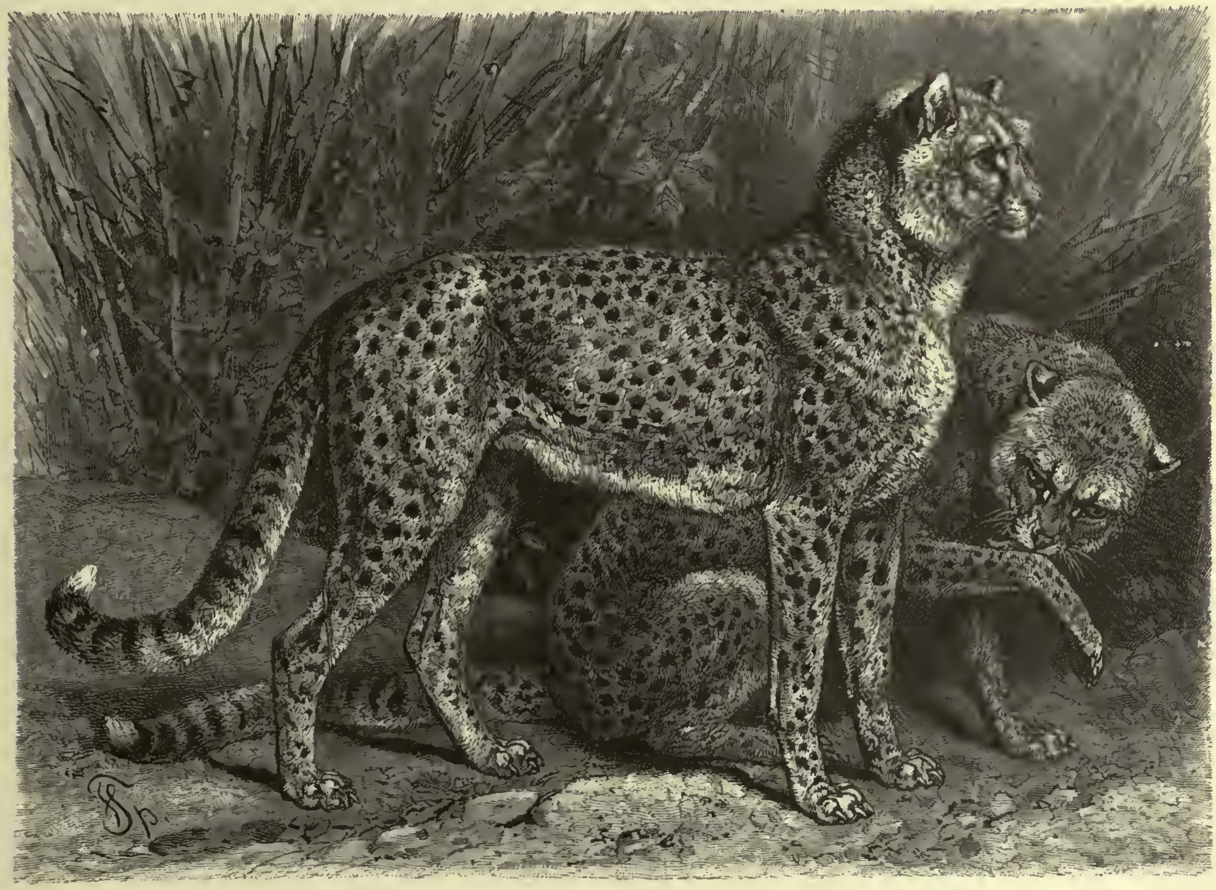


Fig. 73.—Fahhad or Maneless Hunting-leopard (*Cynailurus guttatus*). page 162.

In this family we distinguish three genera: the **Cheetahs** or hunting-leopards (*Cynailurus*), with long thin legs and non-retractile claws; the **True Felines**, forming the genus Felis, with short strong legs, retractile claws, and 30 teeth; and the **Lynxes**, forming the genus Lynx, with longer legs, retractile claws, and only 28 teeth. This last genus is also distinguished from the other two by the shortness of the tail and the possession of tufts of hair on the ears.

THE CHEETAHS OR HUNTING-LEOPARDS.

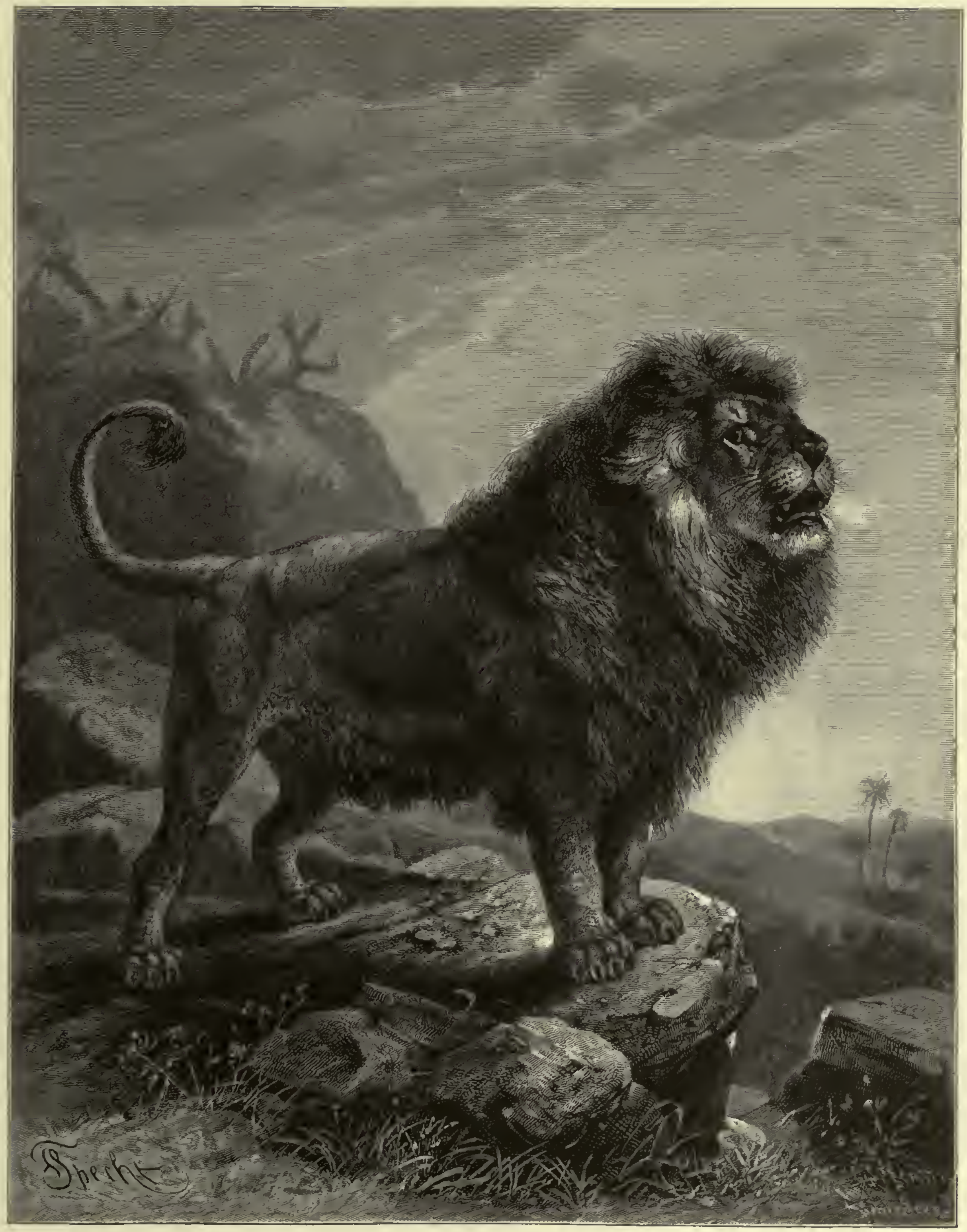
(CYNAILURUS).

This genus consists of only two species, differing but slightly from one another, one of which, the **Fahhad** of the Arabs (*C. guttatus*), fig. 73, inhabits Africa, while the other, the **Cheetah** (*C. jubatus*), is a native of Arabia and Asia Minor. The genus may be shortly characterized as one having a cat's head with a dog's body marked with spots. The two species, which are of about the size of a large greyhound, are only distinguished by the fact that one of them, the cheetah, has a mane on the neck. The yellowish-red or orange-coloured fur, marked with brown and black spots, which run into one another so as to form rings on the rather long tail, appears to be admirably adapted to the general colour of the ground in the deserts and steppes, where these animals prefer to roam. The legs are long and slim, as slim as those of the Canida, the paws small, the claws curved and sharp, but the elastic ligaments which ought to hold them back are so weak that the claws protrude from their sheaths and get worn away in walking. The head is rounded like that of the true felines, the blunt snout rather more protruding. The ears, the eyes with their round pupils, and the dentition present no variation whatever from the forms characteristic of the Felida generally. The voice, too, is the same. The hunting-leopards roar, purr, and hiss like true felines, they likewise growl as they do; but they also utter peculiar sounds which the Arabs have imitated in the names which they apply to these animals.

The cheetahs hunt singly or in pairs, and their ordinary prey is antelopes, which inhabit the same lands as they do. They endeavour to outwit these cautious animals by crawling up towards them on the ground against the wind. But they do not content themselves, like the true felines, with a single bound in endeavouring to overwhelm their victims. They make several leaps, and even dart headlong like greyhounds after the flying animals, though, indeed, only for a rather short time. Have they learned from their victims the method of using their fore-paws? One might almost believe it, for they stamp with their weak paw on their overthrown prey as roe-deer and antelopes do.

The character of the cheetahs is of the same mixed nature as their bodily structure. Like the dogs they are easily tamed, become attached and faithful servants of their masters, but this only till the chase begins, when their whole behaviour at once becomes that of genuine felines. The Arabs used formerly to train them to hunt gazelles more frequently than they do now. The cheetah is conveyed in a wagon drawn by oxen to the neighbourhood of a flock of gazelles, whose mistrust is not aroused thereby since they are accustomed to the sight of such vehicles. But as soon as they have got sufficiently near the game, the hood which had been thrown over the head of the cheetah is taken off, and the animal slips down from the wagon, crawls forwards, often by circuitous routes, in order to get under the wind, and finally, when it has got near enough, making two or three enormous leaps, pounces on the victim which it had singled out, and knocks it down, but sometimes allows itself to be dragged along in wild career while it tries to seize its victim by the throat. The hunters dash down with the greatest haste, again place the hood over the cheetah, which greedily gulps down the blood of its victim, and after they have allowed it its hunting-right, bring it back to the wagon. In the Middle Ages this mode of hunting was held in as high honour among the Mongols as hunting with the falcon.

Nothing is known of the mode of life of these beautiful animals in a state of freedom.



To face page 162.

PLATE VIII. — THE BARBARY LION (*Felis leo*).

UNIVERSITY
OF
CALIFORNIA

THE TRUE FELINES

(FELIS).

The genus Felis, the members of which are spread over the entire area occupied by the family as a whole, includes indeed numerous species and varieties, but exhibits so much uniformity in general structure that it is impossible to divide it up into smaller groups of less value. There is certainly a great difference between a lion or tiger and the wild cat as regards size; but in all other respects the felines resemble one another so closely, and the intermediate forms are so numerous, that we glide in a sense from one extreme of the series to the other without being able to find a halting-place. The characteristics assigned by us to the family are true for all the members of the genus without exception, and we can add only a few details pertaining to their peculiar conditions of life.

Felines of the Old World.

Among the large species the first place is assigned by most to "the king of beasts," the **Lion** (*Felis leo*), Plates VIII. and IX., which is distinguished by its form, by the mane which adorns the male, by the uniform colour of its coat, which is always yellowish, but varies from pale yellow to brown or even black in places, by the existence of a horny wart at the end of its tufted tail, and by the disproportion between the powerful shoulders and fore-limbs and the relatively weaker and less-developed hind-limbs. This disproportion is apparently increased in the males by the presence of the mane, and is less noticeable in the lioness, which in youth indeed is elegant in form, but in adult years does not become more beautiful, since it is a good deal disfigured by its loose hanging abdomen and teats.

An adult lion may attain the length of about five feet, measured from the point of the snout to the root of the tail. The tail measures about two feet and a half, or rather more. The weight may amount to 440 pounds. It is manifest that such a mass, when suddenly hurled by a mighty bound at the back of an animal, is mostly sufficient in itself to dash the latter to the ground.

The lion ranges over the whole of Africa and a part of East and Central Asia, and the different species vary not a little in size, in the development of the mane, and in colour according to the region in which they are found. The Asiatic lions are the smallest, and may even want the mane, as is the case with a little-known variety belonging to Gujerat. Among the African lions that of the Cape has the most luxuriant mane and the darkest colour, while the variety belonging to the Atlas Mountains, represented in Plate VIII., has a mane of a rather lighter brown, and that of the Senegal (Plate IX.) a mane of a yellowish hue.

The lion is the only true feline which never climbs trees. What it cannot reach by a leap of from 10 to 13 feet in height is safe from its claws. Lion-hunters even frequently resort to the device of constructing screens in the trees, behind which they conceal themselves close to a fastened victim, which serves as a lure, attracting by its cries the royal ravager.

Like all other felines, the lion hunts singly, or in the breeding season in company with the female, and almost always in the dead of night. He scours at a trotting pace wide stretches of country in order to reach the places where he hopes to find his prey. He especially seeks for opportunities of finding the large herbivora assembled together, and with that purpose visits their habitual watering-places and pasture-grounds and the inclosures in which they are kept. The lion is seldom seen by day. During daylight it takes its rest in the thickest parts of jungles and forests, in shady retreats difficult of access, in open caves and clefts in the rocks, and is very unwilling to be disturbed. Yet hunger or the necessity for examining its hunting-ground sometimes drives the lion out by day, and travellers tell of very unpleasant encounters with troops of lions pursuing in broad daylight one of those countless herds of antelopes which roam over Central Africa. But these are exceptions to the rule, and a large number of the anecdotes which are said to testify to a supposed magnanimity characteristic of the lion, have originated solely in the sort of stupefaction which comes over all nocturnal animals when they are compelled for any reason to forsake their retreats by day. The same lion, which at night dashes upon a victim with the rapidity of lightning and instantly puts it to death, will pass it by untouched, and even flee from it, if it falls in with it by day.

The fable has some truth at bottom if it ascribes to the monarch (to use the language of courts) a certain degree of simplicity. The lion is, in fact, the least wily and the least gifted of the whole feline genus. It makes up for the want of cunning by strength.

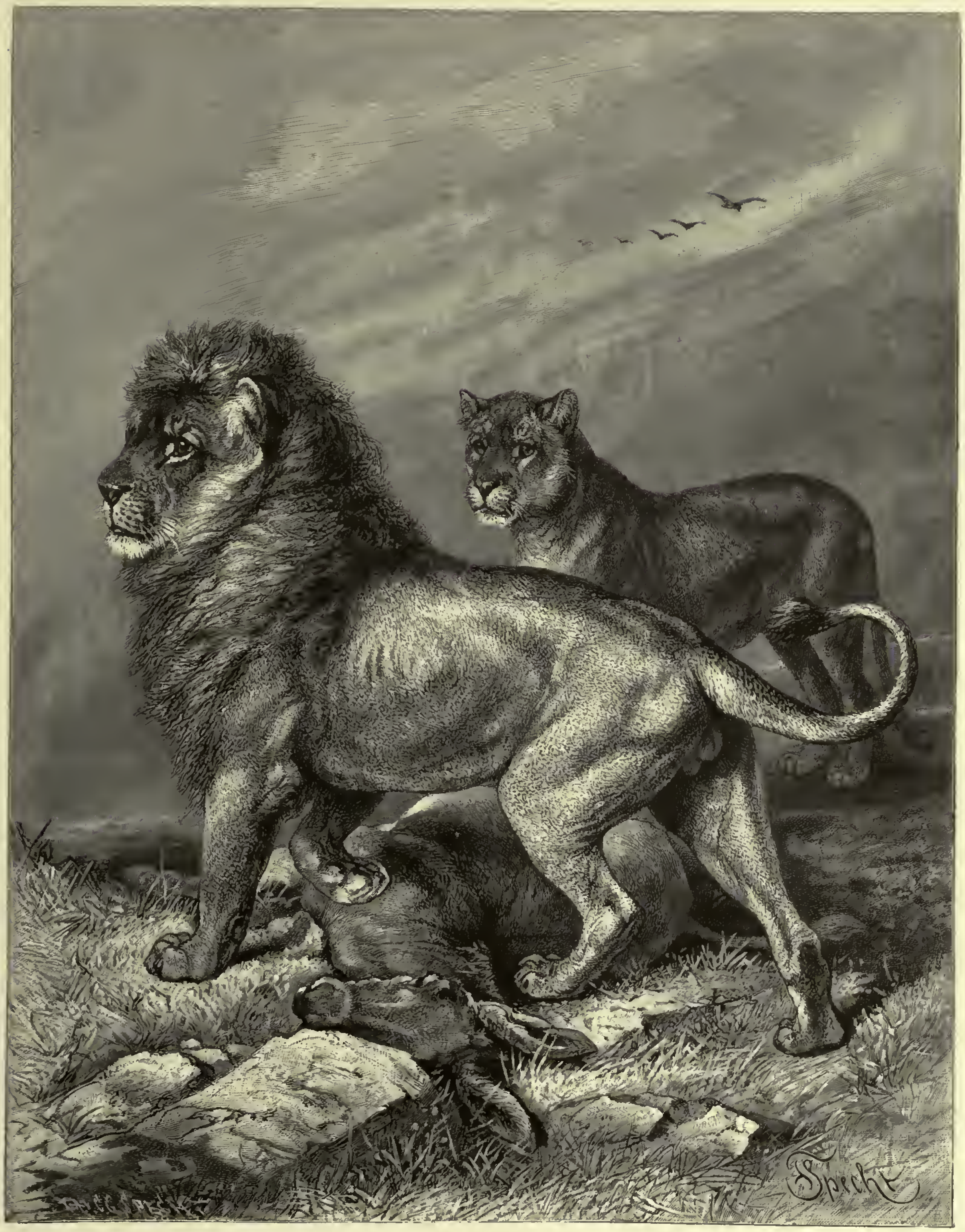
Its strength is, indeed, terrible and astonishing. With a single stroke of its powerful paw the lion breaks the back of a horse, with a single bite it crunches to fragments the neck vertebræ of a cow. If the lion, in the vast regions inhabited by wild, wary, and experienced animals, lies in wait for its unsuspecting victim in well-concealed ambushes, it relies solely on brute strength when it levies its tithe on the herds of domestic animals which are kept in inclosures in the neighbourhood of its lair.

The Arabs compare the roaring of the lion to the roll of thunder. It is observed that the lion gives forth those terrible sounds only when it wishes to warn its comrades, or to strike terror among other animals, all of which, without exception, fall into a state of the greatest excitement and fear as soon as they hear this roaring, and dart away desperately in all directions, and in that way make it easier for the ravager to select a victim.

With respect to this terrible roar Dr. Livingstone is not so awe-struck. "To talk of the majestic roar of the lion," he says, "is mere majestic twaddle. On my mentioning the fact some years ago the assertion was doubted, so I have been careful ever since to inquire the opinions of Europeans, who have heard both, if they could detect any difference between the roar of a lion and that of an ostrich; the invariable answer was—that they could not when the animal was at any distance."—*Miss. Travels in S. Africa.*

We will not go into detail with regard to the thousand narratives of more or less dangerous lion-hunts, of attacks upon and attacks by lions. The lion attacks man or retreats before him according to the degree of his hunger, or according to the time of day or night. Old experienced lions which know how little danger they are exposed to in breaking in upon the villages of the badly armed negroes, will, it appears, hanker after human flesh. Bright fires are the best protection for the camps. Who can wonder that an animal conscious of so much strength as the lion should defend itself with uncommon energy? The story of Livingstone, who was thrown down and severely wounded by a lion which he had pierced with two bullets, is well known. The dying lion crushed Livingstone's arm with its teeth, and, in addition to that, made a plunge at two men who were hastening to their master's assistance. One of them received a terrible bite in the thigh, while the other had his shoulder lacerated. Speaking candidly, shall we conclude from such occurrences that the lion is very ready to attack man?

The ravages which lions commit among the flocks of the natives and the colonists in Africa are very considerable. We know what devastation they used to cause in Algeria, where all the cattle-rearers laid their account with having to share more or less of their stock with these beasts of prey. At the



To face page 161.

PLATE IX. — THE SENEGAL LION (*Felis leo*).

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

present day nothing more is heard of the lion in Algeria. The European hunters have managed to rid the country of them entirely. It is now impossible to have such hunts in the colony as those which were carried on by Jules Gérard, who used to stand unprotected in the moonlight awaiting with firm foot the onset of the lion, and then, just at the instant when the animal was crouching on the ground a few yards off, preparing to take his fatal spring, would smash his skull with a well-aimed ball which struck between the eyes. Formerly the Arabs organized great lion-hunts, when they used to form a ring round his lair, and all fired together on his appearance. Almost invariably the lion, whether wounded or not, would break through the circle, killing or wounding some of the hunters before he breathed his last. The native Negroes and Kaffirs hunt him fearlessly in the same manner, though only armed with lances. Others capture him in snares or pitfalls. Everywhere he has given way before firearms much more quickly, and, we may well say, in a much more cowardly manner than the tiger.

When there is plenty of food the lion commits great ravages, killing every day a large animal such as an antelope, buffalo, zebra, or wild boar, the remains of which it leaves to the hyænas and jackals. When urged by hunger it will even attack carrion, but never except with great reluctance. The powerful Cape buffaloes are the only animals which often wage successful battle against this assailant. The lion never attacks the elephant, the rhinoceros, or the hippopotamus; he knows only too well that the struggle would not always terminate in his favour. Conscious as he is of his strength he nevertheless prudently withdraws.

The lioness gives birth to three or four cubs at a time, and these are born with open eyes, and are of about the size of a small cat with a large head. The mother shows great fondness for them, and takes delight in their sports.

When caught young the lion can easily be tamed, and becomes attached to its keeper; and it easily breeds in captivity. Most of the lions which are exhibited in menageries and zoological gardens have been born within the bars of a cage. Even the ancient Egyptians knew how to tame the lion, as we can see from numerous drawings and sculptures on their monuments. The Romans of the Empire used immense numbers of lions for their games in the circus. It is probable that the lion still inhabited the Balkan Peninsula within historical times, but at the present day it is entirely banished from European soil.

The majestic aspect of the male lion, which is incontestably a type of calm conscious strength, has procured for this animal an undeserved reputation. The lion has been credited with all the attributes of a ruler magnanimous even in his wrath, has been depicted as full of compassion for the weak, grateful for services rendered to him, and indulgent towards an overthrown antagonist. It would be in vain to seek in the accounts of those natives who have become acquainted with the king of beasts in a state of freedom, for traits corresponding to these enthusiastic prepossessions. The lion is a feline and nothing more than a feline, sluggish and not easily moved by day, but by night a mighty beast of prey, employing craft and force alternately, terrible when hungry, indolent when satiated. The captured lion easily resigns himself to his fate. When trained from youth up he even shows less independence of character than his small ally, the domestic cat. But like the latter he has moments of ill-humour, which he vents not in a few light scratches, but in serious and often fatal wounds. Most lion-tamers can tell us something of that.

The **Tiger** (*Felis tigris*), which is represented in fig. 74 as he is seen dashing through the forest, is inferior to the lion neither in strength nor size, and surpasses him in courage and savagery. The ancients did not become acquainted with him till late, not till the time of Augustus; and it is probable that if he had been known earlier he would have received the place of the lion in fable.

The body of this powerful beast of prey exhibits much more pleasing proportions than that of the lion. The breast is beautifully proportioned to the hinder part of the trunk. The rather smooth hair lying close to the body allows the undulating lines of the head, trunk, and limbs to be clearly seen. Old males have been killed with bodies measuring six and a half feet from the tip of the snout to the root of the tail, while the tail was just half that length. The head is rounded, with a somewhat conically arched profile. The face is bordered by nearly white whiskers, which are pretty long, bushy, and stiff, and give the old male a very dignified appearance. The pupils are round, the paws enormously broad, the legs very powerful and not very long.

The tiger is a large striped cat. The ground colour of his fur is a yellowish-white, sometimes passing into reddish-yellow, darker on the back than on the under side, where it is almost a pure white; and this ground-colour is variegated with dark-brown or even black transverse stripes which stand out in strong contrast. The tigers of the north have a paler coat, and in winter even have a pretty thick wool between the longer hairs.

The territory occupied by the tiger is tolerably extensive. From the large Sunda Islands to the banks of the Amur, and from China to Caucasia, he is met with everywhere in Asia; but he manifestly prefers the low districts of the torrid zone, the dense bamboo thickets, the jungle, and similar places, where he can easily find secure retreats, from which he can dash down with a mighty spring upon his victim, as shown in the illustration. He adapts himself to very different conditions of life. He makes himself at home on the bare steppes and upon stony plateaux, in primeval forests as well as on the hills clad with a dense foliage of bushes, in thickets as well as on the cold and dreary flats of Eastern Siberia, where in winter he digs out his lair in the thick snow. No impediment stops him in his migrations in search of rich hunting-grounds. Notwithstanding his weight he climbs on low trees, and swims not only across rivers but even across arms of the sea, as, for example, across the channel which separates Singapore from the mainland.

Although the tiger prefers large animals for booty, it does not despise the small ones. It is said to be just as fond of the various species of pheasants and peacocks as of the buffaloes, stags, and wild boars which inhabit the forests of India. Of all animals it shows least fear of man. The lion shuns man when armed with a firearm; the tiger seeks him out. It may justly be said that no animal levies so serious tithes on the natives as the tiger does. In spite of the incessant hunting parties of the English, thousands of human beings are killed by these ravagers every year in India. In all the village districts so-called 'man-eaters' are known, that is, old tigers which seek no other kind of game, and are wily enough to escape all pursuit. Among the animals of these districts it is only the elephant, the rhinoceros, and the Indian black bear (*Ursus labiatus*), often also the buffalo, which can make a successful stand against this assailant. There are even well-established cases in which buffaloes have got rid of a tiger that had leaped on their neck by pressing their enemy violently against a tree so that he fell off, and have afterwards put him to death by repeated thrusts with their horns. But such battles are rare. In most cases the animal attacked breaks down under the first shock of the heavy tiger, which dashes down upon the back of its neck with an enormous bound, lacerates its loins with its claws, and tears open its throat with its teeth.

On the subject of the man-eater, Mr. G. P. Sanderson, officer in charge of the government elephant-catching establishment in Mysore, makes the following remarks:—

"This truly terrible scourge to the timid and unarmed inhabitants of an Indian village is now happily becoming very rare; man-eaters of a bad type are seldom heard of, or if heard of, rarely survive long. Before there were so many European sportsmen as there now are in the country, a man-eater frequently caused the temporary abandonment of whole tracts; and the sites of small hamlets abandoned by the terrified inhabitants, and which have never been reoccupied, are not uncommonly met with by the sportsman in the jungles. The terror inspired by a man-eater throughout the district ranged by him is extreme. The helpless people are defenceless against his attacks. Their occupations of cattle-grazing or wood-cutting take them into the jungles, where they feel that they go with their lives in their hands. A rustling leaf, or a squirrel or bird moving in the undergrowth, sets their hearts beating with a dread sense of danger. The only security they feel is in numbers. Though the bloodthirsty monster is perhaps reposing with the remains of his last victim miles away, the terror he inspires is always present to every one throughout his domain. The rapidity and uncertainty of a man-eater's movements form the chief elements of the dread he causes. His name is in every one's mouth; his daring, ferocity, and appalling appearance are represented with true Eastern exaggeration; and until some European sportsman, perhaps after days or weeks of pursuit, lays him low, thousands live in fear day and night. Bold man-eaters have been known to enter a village and carry off a victim from the first open hut. Having lived in a tract so circumstanced until I shot the fiend that possessed it, and having myself felt something of the grim dread that had taken hold of the country-side, where ordinary rambling about the jungles, and even sitting outside the tent after dark except with a large fire, or moving from the encampment without an escort were unsafe, I could realize the feelings of relief and thankfulness so earnestly expressed by the poor ryots when I shot the Jezebel that had held sway over them so long.

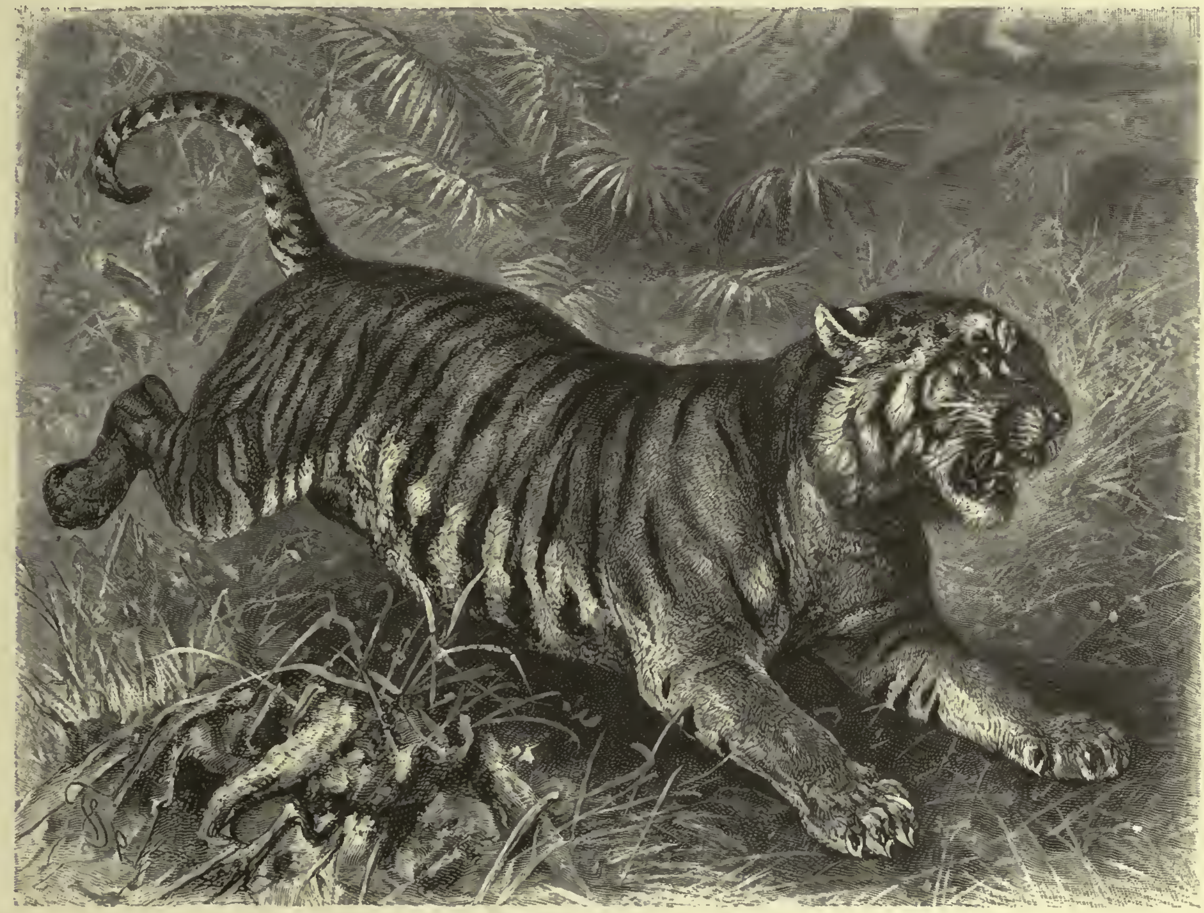


Fig. 74.—The Tiger (*Felis tigris*). page 165.

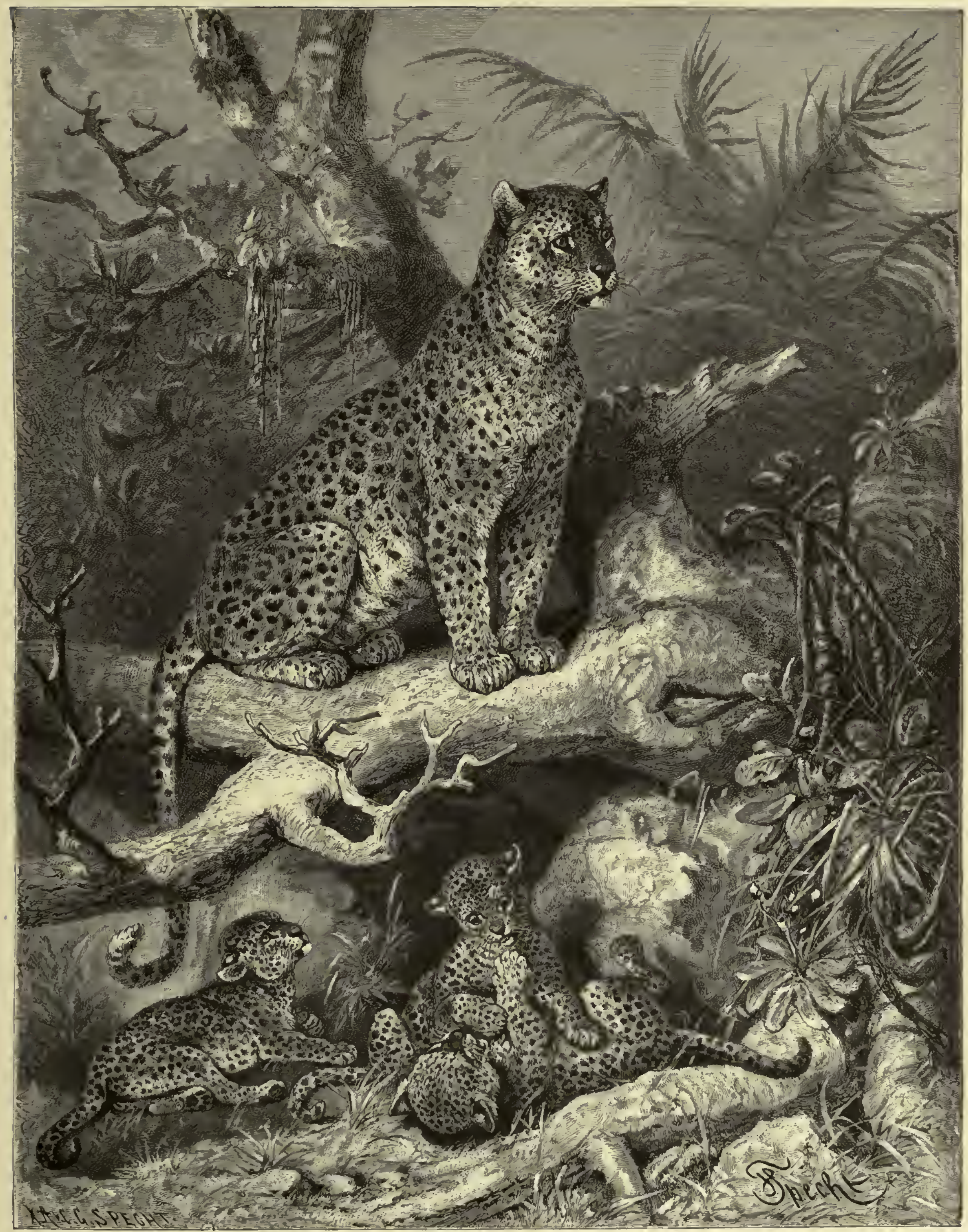
> "The man-eater is often an old tiger (more frequently a tigress), or an animal that, through having been wounded or otherwise hurt, has been unable to procure its usual food, and takes to this means of subsistence. . . The man-eater is as cowardly as it is cunning, fleeing before an armed man, between whom and a possible victim it discriminates with wonderful sagacity. The slightest sound of any one in pursuit of it, even the whisper of a single sportsman with one or two trackers in its haunts, starts it at once; it will then probably travel for miles, though even whilst fleeing it may pounce upon some unwary victim, as I have seen an ordinary tiger seize a bullock when itself the object of hot pursuit. This combination of cowardice and audacity constitutes the difficulty there always is in bringing a man-eater to bag."—*Thirteen Years among the Wild Beasts of India.*

Tiger-hunting is much more dangerous than lion-hunting, because the tiger is much wilier than the lion, and knows so well how to hide itself that it almost always falls upon the hunter unexpectedly. In India and China large hunting-parties used to be organized on a scale worthy of a military expedition. Thousands of armed men and hundreds of elephants were assembled together, the lairs and hiding-places of the savage beast were surrounded, and it was endeavoured to inclose him within a ring of lances. This ring was indeed often enough broken through, not without dead and wounded being left behind. Now-a-days the hunt is organized on a more modest scale, and yet it leads to better results. All possible means, even torches and rockets, are employed to scare the tiger from his lair. The animal is caught in nets, in traps, in pitfalls covered with bushes. Good marksmen accompanied by dogs seek him out under the direction of experienced guides, and try to kill him with a rifle-ball. This kind of sport is, indeed, a very favourite one in India, but extremely dangerous. Many an English officer has thereby been maimed for life, for the wounds made by the claws and teeth of a tiger are always very severe. For the extermination of such an enemy of human kind all means are good, but, notwithstanding the high premiums which the Indian government and the native rulers pay to the successful hunter, the extirpation of the tiger is a slow process.

If we would say anything of the behaviour of the tiger in captivity we should merely repeat in a great measure what has been said about the lion. It is worth mentioning, however, that even the tiger born in a menagerie or a zoological garden, and kept tame from birth, is always more to be dreaded than the lion. The instances of a return to the savage condition are more frequent in the case of the tiger. The tiger, however, agrees with the lion in being easily propagated in captivity. It has even been found possible to produce hybrids between a lion and a tigress.

Africa, Asia, and the Sunda Islands harbour large spotted felines, which have been designated by the names of **Leopards** and **Panthers.** Are they species? Are they varieties? The question still remains unanswered. Certain it is that the panther of Java (*Felis variegata*) has a smaller head, longer neck and tail, more slender body, and more simple and more numerous spots than the rest of his kindred; but it is equally certain that it occurs in a quite black variety, whose spots can only be discerned in sunlight, and which was considered to be a separate species until black and spotted young ones were found on one occasion to be born together of the same mother.

Be this as it may, it must at least be acknowledged that the **African Panther** (*Felis Leopardus*), to which some would restrict the name of leopard, and the **Asiatic Panther** (*F. Panthera*) are extremely like one another, and that the name panther is the only one in use in Algeria. The general colour of these two felines is a light yellow ochre, inclining on the back to brown, on the under-side to white, while the spots are black. In both species two different kinds of spots are scattered


X.A.v.G.SPECHT
F. Specht

To face page 168.

PLATE X. — THE LEOPARD (*Felis leopardus*).

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

over this light-coloured garment; smaller angular complete spots, and larger circular, or rather ring-shaped ones, surrounding a rose-coloured or yellowish-red centre. But in the African form the complete spots, which are crowded together, are found only on the sides, and on the back are replaced by the ring-shaped spots, while in the Asiatic form the latter kind of spots are not so closely crowded together, and cover the whole body except the head and lower part of the legs. These differences are certainly too slight to suffice for the distinction of two different species.

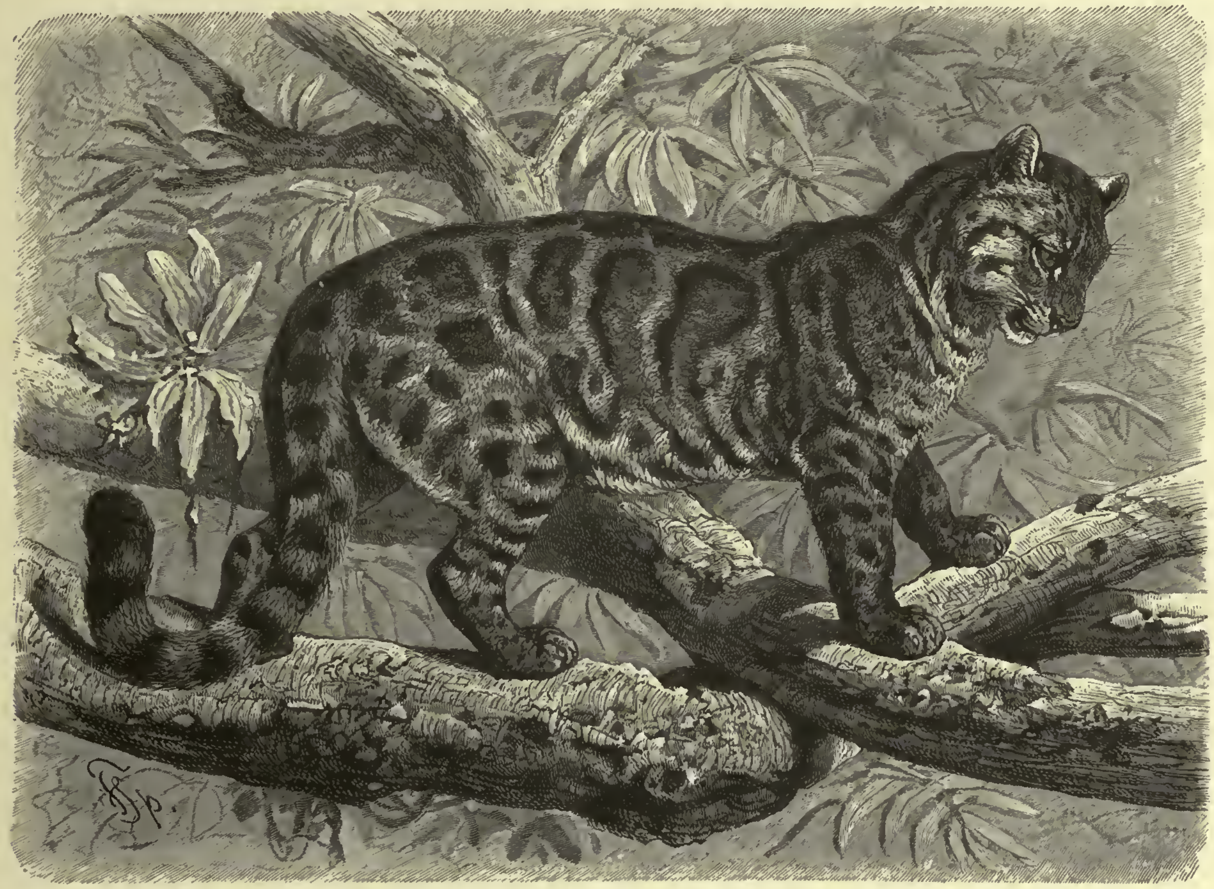


Fig. 75.—The Clouded Tiger (*Felis macroscelis*). page 170.

In Plate X. one of these felines is represented sitting erect on the branch of a tree, underneath which her young ones are playing, while she herself keeps watch all round with eager attention. Her beautiful eyes are staring steadfastly in one direction. Is she looking for prey? Does she spy any danger? One may be sure that she would dart with lightning-like rapidity on any enemy or any careless traveller that might venture to approach, that she would know neither fear nor mercy if it were a matter of protecting her brood.

Panthers do not attain the size of the tiger, but they are nevertheless terrible enemies for every creature, even for man. Nothing equals the grace, the elegance, the lightness of the panther, when like a serpent he winds through the bush crawling on his belly. He shows wonderful skill in hiding himself amidst the branches of trees, and for hours together he will lie stretched out his whole length upon a branch, with his legs hanging down on both sides, patiently and quietly waiting without any other movement than a gentle vibration of the tip of his tail, ever on the watch for an animal to make his prey or an enemy to attack. In those parts in which he has made acquaintance with firearms he tries to avoid man when he can, without, however, greatly fearing him, and the most experienced hunter may pass by in the immediate neighbourhood of a crouching panther without suspecting his presence, while the panther, on the other hand, is observing with watchful eye his slightest movements. When wounded or tormented by the pangs of hunger the panther becomes terrible. He darts out unexpectedly on his antagonist, and the hunting screens in the trees, which afford entire protection against the lion, are of no avail against this expert climber. The French have succeeded in banishing the lion from Algeria, but all the efforts of Bourbonnel and his bold companions of the chase have not resulted in the extirpation of the panther. The ravages which these beasts commit among flocks and herds are considerable, and their boldness is so great that even yet they venture near towns. These ravages are all the more serious because the panther, like others of the beasts of prey of which we have spoken, kills more than enough to satisfy his hunger, when he has once managed to break into an inclosure or a stall. The fires which keep off the lions seem rather to attract the panther. On the other hand large dogs, which tremble at the sight of the lion, attack the panther with courage, and the latter, in spite of his desperate defence, cannot escape, where there are no trees, from a numerous pack of good dogs.

In the forest the panther easily eludes his assailants by climbing a tree. The hatred shown by dogs he repays with interest, and isolated watch-dogs easily become his prey. Among wild animals wild boars, antelopes, monkeys, and the hyrax appear to be his favourite victims. Even porcupines, however, are not protected by their spines. Among domesticated animals the panther prefers, when he has the choice, goats to sheep, which are somewhat protected by their wool; but he also attacks asses and mules, and in the farmyards and villages does not despise either dogs or cats nor even poultry. When tamed he is delightful on account of his mild and affectionate disposition and caressing ways, but always dangerous from the liability of his bloodthirsty instincts to return.

The **Clouded Tiger** (*F. macroscelis*), fig. 75, a native of Siam, Borneo, and Sumatra, is an animal with a longer body than the previous species, and with a different colouring of the coat, which shows a tendency in the spots to assume a striped arrangement. The ground colour is a dull gray inclining to yellow or red. The paws and tail are covered with small black complete spots, while on the sides there are large spots arranged in series, and the head and neck are marked with longitudinal parallel stripes.

The character of this feline, which may attain the length of three feet or more, appears to be the opposite of that of the panther. The natives, indeed, detest the clouded tiger as the ravager of their poultry yards, but do not fear it at all. It lives in the woods, where it chiefly hunts after small mammals and birds. The few specimens which have been brought to Europe exhibited a gentle disposition. They easily became familiar with man and even with dogs, were fond of being caressed, and behaved altogether like domestic cats.

In the **Marbled Cat** (*F. marmorata*), fig. 76, which likewise comes from the Sunda Islands, and reaches about the size of a large domestic cat, the arrangement of the spots in stripes becomes still plainer. The paws and the tail are still marked with small black spots, while broad brown and black stripes extend over the sides and neck. The animal lives in the forests of Borneo and Sumatra in the same manner as our wild cat, and in captivity behaves like the domestic cat.

There was long a controversy as to the origin of the latter. At the present day doubt is no longer possible. Our cat still lives in a wild or half-wild state throughout the interior of Africa, in the Soudan, in Abyssinia, and even in Palestine, and has been called by Rüppell, who first discovered it, the **Fallow Cat.** It is also known as the Gloved Cat (*F. maniculata*), fig. 77. On a careful comparison of the skeleton of this wild cat with that of the mummies of cats which are found in plenty in the Egyptian monuments, as well as with the skeletons of our domestic cat, the complete agreement of the two has been thoroughly established. The examination of the half-wild cats that roam about in the villages of Nubia and Abyssinia, and which have nearly preserved the form and markings of the wild species, has only confirmed this result. The fur of the fallow cat has a yellowish or reddish colour, darker on the back and lighter on the under side. The legs and tail are ringed, as in our domestic cat; on the head there are some darker longitudinal stripes, and on the sides confused irregular marblings. It is proper to observe here that all our domestic cats, even those which afterwards become quite black or white, have when young a ringed tail, though the rings are indeed often only very faintly marked.

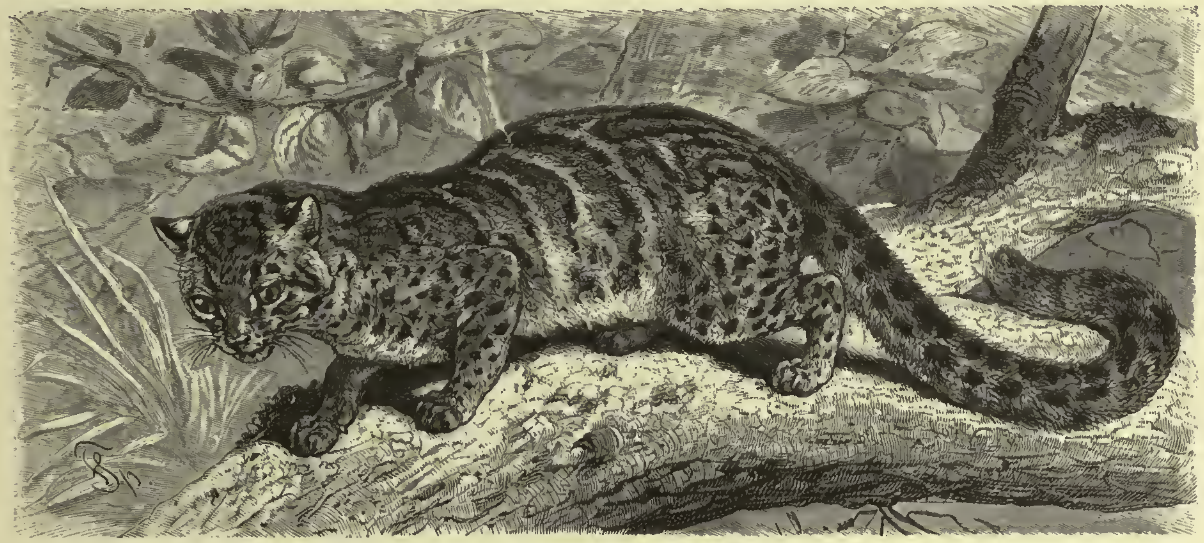


Fig. 76.—The Marbled Cat (*Felis marmorata*).

The fallow cat seems as much at home among the scanty bushes of the steppes as in the primeval forests of Central Africa, where, like our wild cat, it pursues small rodents and birds. When caught young it is easily tamed, and attaches itself to man, or rather to human dwellings, even in those countries in which the inhabitants certainly take no care of it. The ancient Egyptians undoubtedly obtained it from the interior of Africa, and afterwards they held it in such reverence that the unhappy wight who, even through accident, had caused the death of a cat was regarded as a murderer and punished with death. The ancient Greeks were unacquainted with the cat. No bones belonging to it were found in the ruins of Troy. Herodotus told his countrymen of the animal as he had observed it in Egypt. It was in Egypt that the Romans became acquainted with it.

Now all our domestic animals derived from India, or from Asia generally, were known to the ancient Aryans, and since the domestic cat was unknown to all the ancient Aryan races, the inference that the domestic cat is derived not from Asia but from Africa is obvious. The domestic cat has accordingly been introduced into the countries north of the Mediterranean by the Romans, who obtained it from Egypt; and the nations that followed the Romans, the Arabs and Semites in general, brought it further west. Now-a-days this useful hunter of small rodents has been spread by man over the whole earth, but in the tenth century of our era the domestic cat was still so rare, that it was regarded in England as an animal of great value, with regard to which the laws named certain defects which made a sale invalid, just as at present in the case of horses. Man has formed various races, but since the cat has always preserved a certain independence in the gratification of its sexual instincts, these races are much less numerous and less divergent from one another than those of other domestic animals.

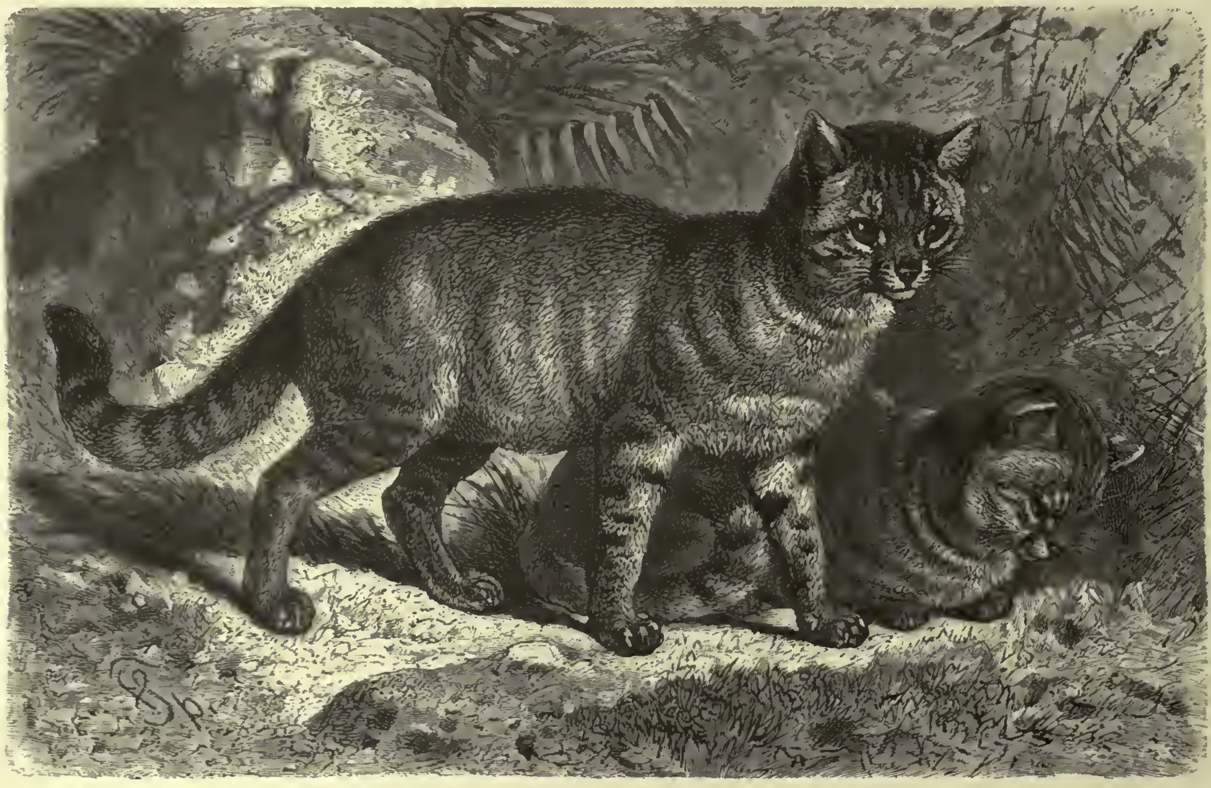


Fig. 77.—The Gloved or Fallow Cat (*Felis maniculata*). page 171.

The **Wild Cat** (*Felis catus*), fig. 78, of our part of the world is much larger and stronger than the domestic cat. The head is relatively thicker and larger, the body more powerful, the tail shorter, the fur thicker, the teeth sharper. The fur has a grayish-yellow ground with black stripes, which are specially well marked on the head, back, sides, and very bushy tail. The legs are short, the paws very strong and broad.

It is essentially a European animal, which scarcely crosses the Caucasus, but is found everywhere in dense forests as far as the limit of trees. Decidedly nocturnal in its habits it spends the day in holes in trees or hidden among the foliage in tree-tops, sometimes in clefts among the rocks, often even in the deserted hole of the fox or badger. On the approach of night it leaves its place of concealment and betakes itself to its solitary hunt. It is only during the season of heat that a pair may sometimes be seen together. This season passed, the sexes hunt separately. All the hair-clad and feathered denizens of the woods, from the young roedeer to the mouse, from the eaglet to the thrush and wren, become the prey of this fierce hunter, who combines strength with agility, boldness with cunning. The wild cat is a tiger on a small scale. It approaches noiselessly, makes a great spring to seize its victim, but does not pursue, and always turns back ashamed when it has missed its aim. It knows very well the habitual resorts of its game, where to lie in wait, and patiently expect the hare as it comes from the wood to pay a visit to a neighbouring field. I have myself shot in the Odenwald a wild tom-cat which had placed itself on the watch opposite me. I had been warned by a slight rustling among the dry leaves, but the animal on reaching its chosen spot remained motionless, and I lay in wait for him in vain for an hour before a favouring moonbeam enabled me to take aim at him amidst the bushes. The wild cat seldom pursues its prey beyond the limits of the woods in which it roams. Its visits to poultry-yards are confined to the neighbouring villages and the woodland houses of foresters. The chief food of the wild cat consists of field-mice, voles, rats, and other noxious rodents; and it has often been asked whether they should not be protected instead of being relentlessly pursued. As regards this question, as in the case of the fox also, different interests clash. Game has scarcely any deadlier enemy among our wild animals than the wild cat; the hunter accordingly will make every effort to extirpate it. On the other hand, the peasant and the farmer, and indeed even the non-hunting forester, will probably esteem more highly the benefits which these animals confer upon them in reducing the numbers of the game, and especially of the rodents, which injure the forests and the crops. These benefits are certainly not counterbalanced by the slight damage which they themselves do in stealing a few fowls. Yes, it might even be asked, whether the cat is not on the whole of service to the poultry-yards through the successful war which it wages against weasels and fitchets, those insatiable foes of fowls, ducks, and pigeons.

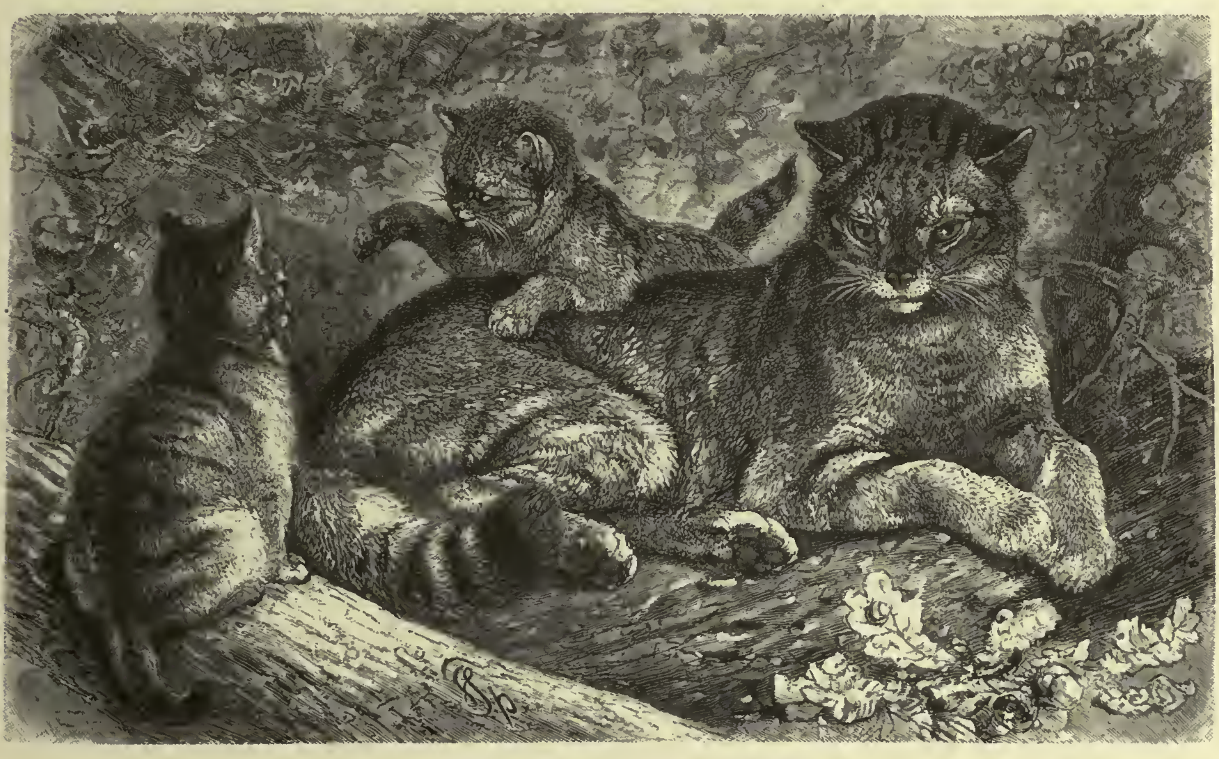


Fig. 78.—The Wild Cat (*Felis catus*).

Dogs pursue the wild cat with all the greater fury, because it, far from fearing them, makes a courageous defence. It requires a pack of three or four strong dogs to master a wild cat. The hunt is even not without danger. If the wild cat is not killed on the spot, it darts savagely upon the aggressor; and cases are known in which hunters have been severely wounded by this courageous animal.

When caught young the wild cat can be tamed to a certain point, but never completely. Its fierce nature is apt to break out occasionally. Not a few instances are known in which it has unexpectedly attacked its master in an access of blind fury. Have our forefathers had the patience to tame this denizen of the woods? This is all the less likely, since the wild cat is not easy to feed, requiring as it does living prey, and never surviving long in captivity. Moreover, the differences which mark it off from the domestic cat are too important to have been obliterated by an imperfect domestication during a few centuries.

Among the numerous felines which inhabit Southern Asia, we may mention also the **Viverrine Cat** (*Felis viverrina*), fig. 79, in which some see the type of a separate group, distinguished by a long slender body, small head, short legs, and tail of moderate length terminating in a point. It is a beautiful animal, reminding us by its gliding movements of the civet cats, and has a soft fur, the colour of which is a grayish-yellow marked with brown spots arranged in longitudinal stripes. In other respects it resembles all the other felines, leading the same kind of life, and not distinguishable by a single important character. The fur is pretty highly esteemed in some places.

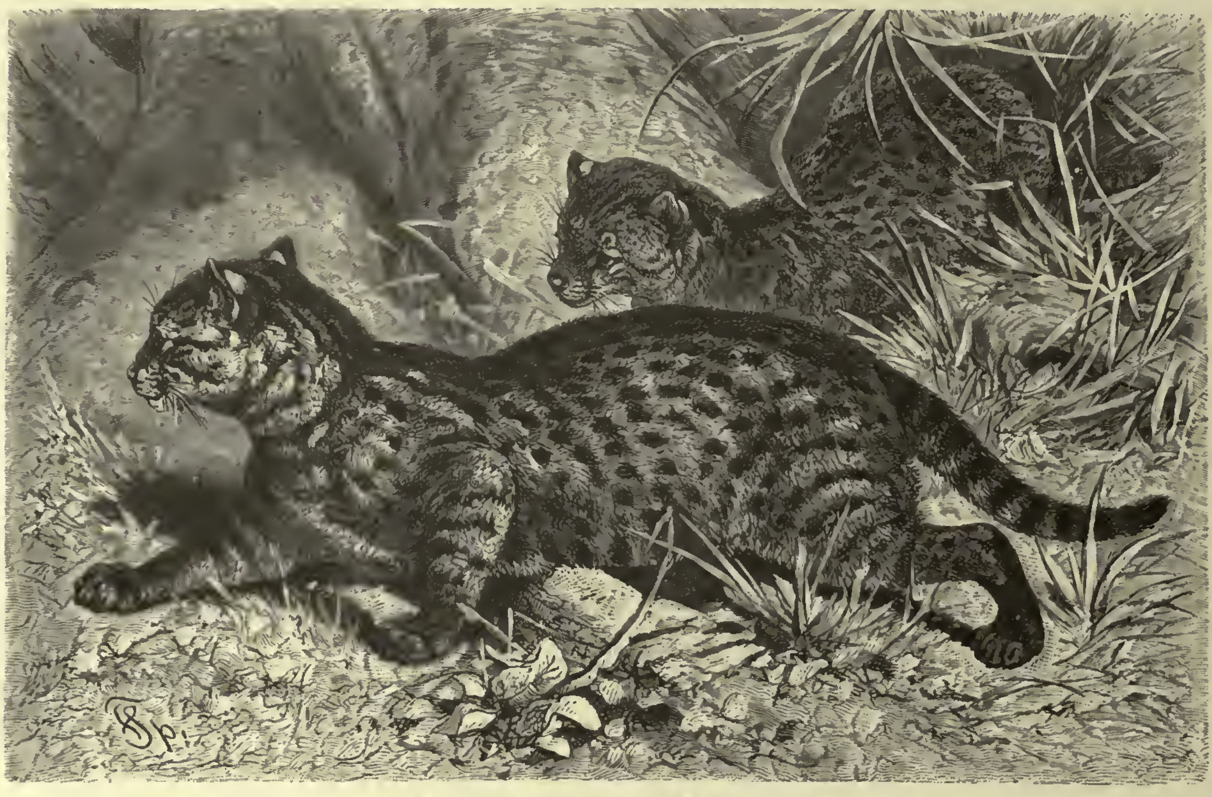


Fig. 79.—The Viverrine Cat (*Felis viverrina*).

The **Serval** (*Felis Serval*), fig. 80, the "boschkatt" of the Dutch colonists at the Cape, forms the connecting link between the felines and the lynxes. The lean, slender body attains the length of three feet or more, while the short, and not very bushy tail measures only about one foot. The legs are pretty long, the head longish, the nose bent, the ears large and shaped like pointed paper-cornets. The serval is an inhabitant of the plains of Africa, where the only wood consists of a few bushes, and is met with from the Cape to Algeria. It conceals itself by day among the branches of the pistachios and tamarisks, or in clefts and caves in the rocks. Its strength enables it to attack antelopes and sheep, but it prefers to make war on the francolin and other birds of the steppes. It is also very fond of paying visits in its own interest to the poultry-yards of the settlers, who on account of this unfortunate passion regard the serval with detestation. It is usually caught in traps. The coarse reddish-yellow fur, over which small brown spots are distributed, is little esteemed by us, but among the negroes of the interior of Africa is so highly valued, that the negro princes wear it as a mark of their high dignity, as ermine was formerly worn by the sovereigns of Europe.

Felines of the New World.

The felines distributed over the whole of the mainland of America form in a certain measure parallel series to those of the Old World, but while the striped or uniformly coloured felines, such as the tiger and lion, in the Old World surpass the others in size and strength, the chief *rôle* belongs in the western hemisphere to the spotted species.

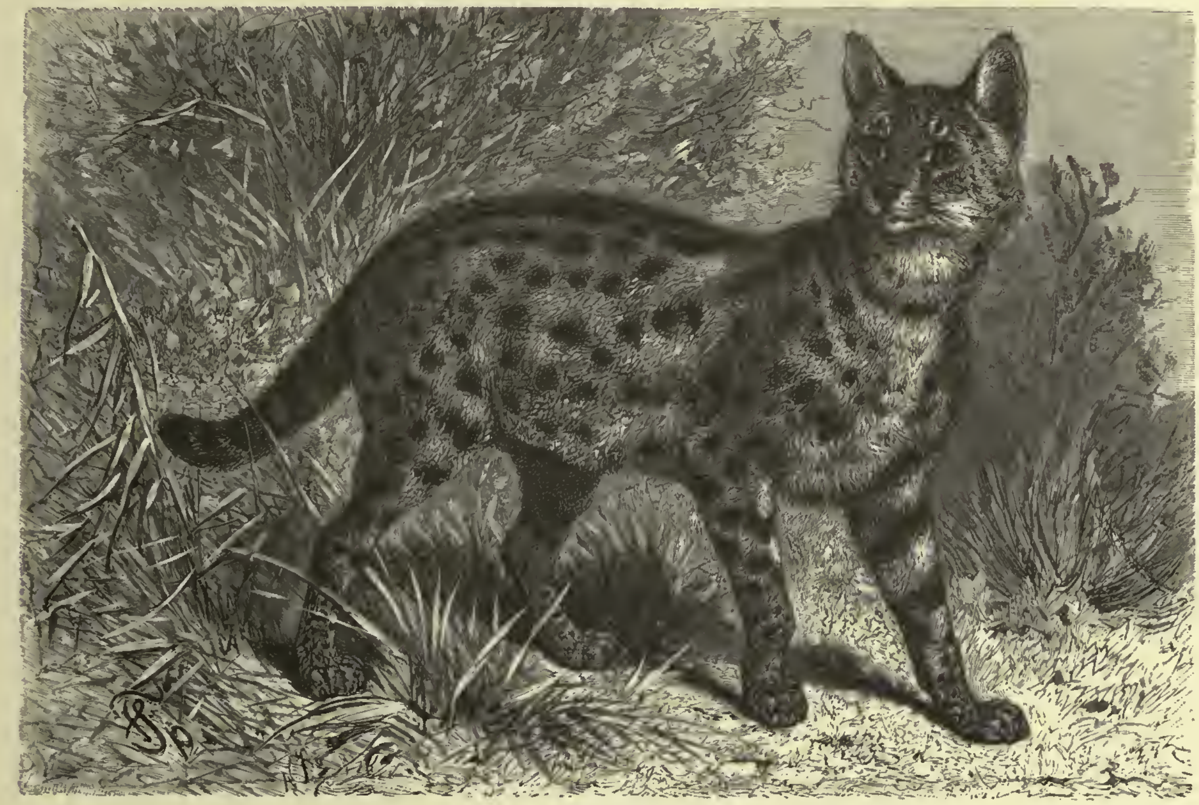


Fig. 80.—The Serval (*Felis Serval*).

The **Jaguar** (*Felis onca*) attains about the size of a tiger, but is not so long or so massive in form, and has shorter legs.

The jaguar is in every respect a large panther, whose range extends over the whole of South America and even part of North America—as far as Texas and South California. Its thick, soft, silky fur is distinguished from that of the panthers of the Old World by the presence of pretty large ring-shaped spots on the sides, shoulders, and thighs, with a few small black points in the centre of the ring, which is rose-red in its ground-colour.

The general colour of the whole fur varies very greatly from yellowish-white to black, but no special homes can be assigned to these varieties. Differently coloured young ones are often found in the same brood.

Plate XI. represents the jaguar crawling on an overthrown tree, on which it is on the look out for a capybara, a large South American rodent, of whose flesh it is said to be peculiarly fond. The jaguar, however, like the tiger and panther, contents itself with any kind of food and any place of abode. It is found on the treeless Pampas of the Argentine Confederation, where it can hide itself only in the tall grass, and is found no less in the densest primeval forests of Brazil. But it prefers the borders of the forest, the shady banks of the great rivers and the standing waters adjacent to them, where it lies in wait for the animals which come to drink. It climbs trees expertly even in pursuit of monkeys, swims across the broadest rivers, and jumps with ease over high hedges and walls. Although it prefers horses and mules, tapirs, peccaries, and capybaras, yet it does not despise rats and agoutis, and knows how to get the better of the armadillos in spite of their armour. Birds seem to be not less tasty to it than the large lizards; it will even attack crocodiles and alligators, is capital at fishing with its paw, like our cats, and it can dexterously empty the carapace of the large turtles, which it turns on their backs when they come to the sandy shores to lay their eggs. Only the oxen of the Pampas can withstand its onset; but these, it must be remembered, were introduced by man, and do not belong to the original native fauna of America.

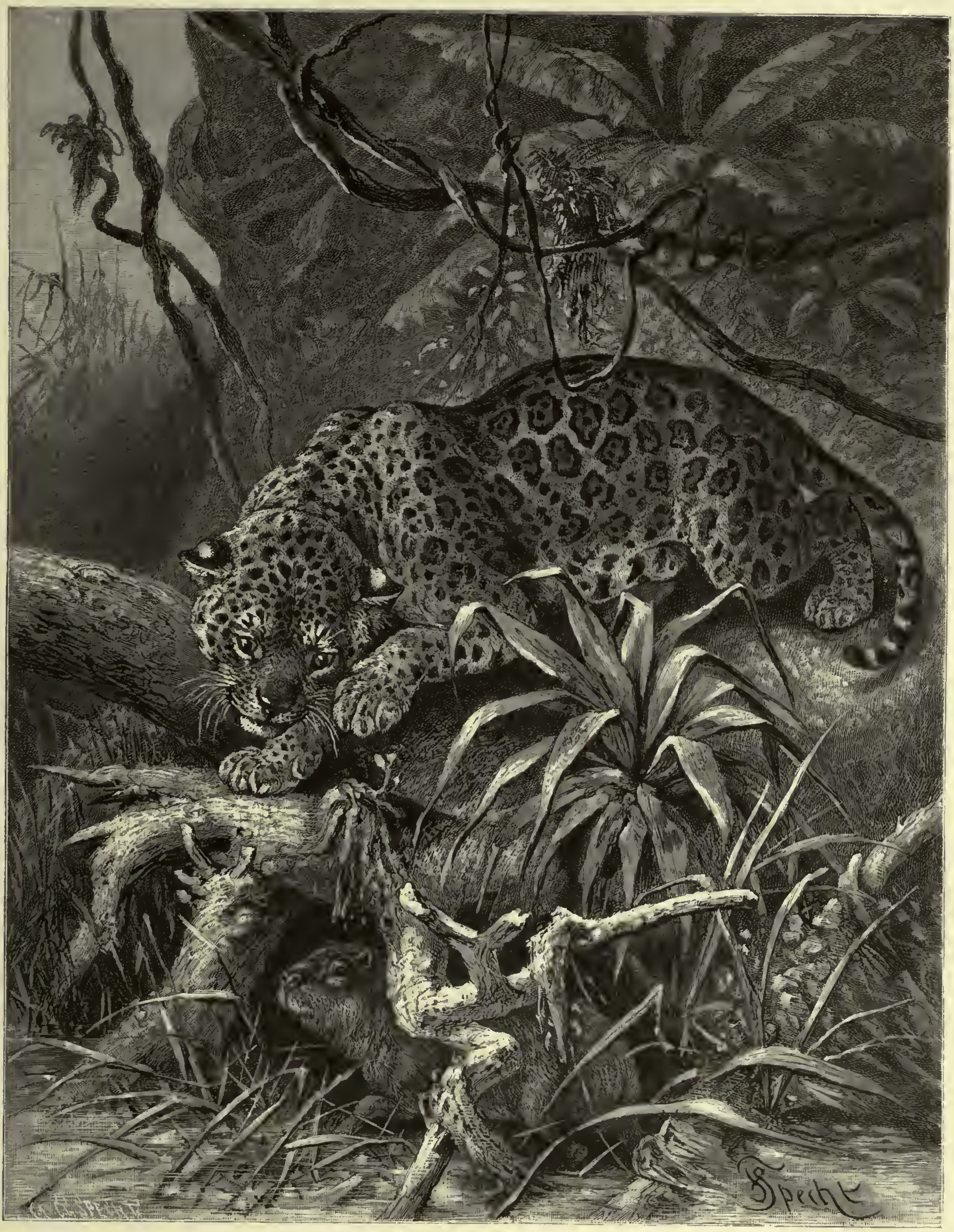
With reference to man the jaguar behaves like the large felines of the Old World. By day it mostly leaves him unmolested, by night attacks and devours him. It flees from him in those parts in which it has become acquainted with firearms; but seeks him out in order to make him its prey when it knows from experience that it runs no great danger. There are "man-eaters" in America as in India, and it is always the old males that devote themselves specially to human prey. It appears, however, that these attacks on the human species are rarer in America than in India.

Besides the modes of hunting adopted in the Old World, others, perhaps more effective, are carried on in the New against the jaguar. Foremost among these is hunting with arrows poisoned with curara, and projected by means of a blow-pipe. The Indians who carry on this mode of hunting march out with a pack of courageous dogs. The jaguar when bayed by the dogs at once takes to a tree, and from this secure station keeps watch on its four-footed assailants, paying little heed to the small arrows with which the Indians prick its skin and cause it no more pain than a thorn would, although in a few minutes they paralyse it. In other cases heroic Indians will advance boldly against it, their left arm merely protected from its bites by a sheepskin, while they transfix its breast with a lance or a large dagger. The Gauchos throw the lasso round it and strangle it, dragging it along as Achilles did the dead body of Hector. But for this mode of hunting an excellently trained high-spirited stallion is required, for at the sight of the terrible ravager most horses tremble in all their limbs, and remain rooted to the spot as if paralysed. It is needless to go into further details, for all that we have said of the tiger and panther can also be applied to the jaguar. Like the panther it does not fear fire, and like the lion it is said to prefer the coloured man to the white.

One would never think of comparing the **Cougar** or Puma (*Felis concolor*), fig. 81, to the lion, if it were not that the coat of this American feline is without markings. The general colour of this coat, however, is somewhat different from that of the lion, inclining more to olive- or grayish-green. With the exception of this uniformly coloured coat, which has no trace of either spots or stripes, everything is different in this so-called American lion. The head, which in the lion appears large and broad, is relatively small in the puma; the profile is not straight, but bent like that of a cat; the body is slender, long, and well-proportioned. The mane is wanting, and so also are the tuft and spine on the tail.

The puma, in fact, shares with the majority of the American felines, a rather longish form of body and short legs. The fact that the young are spotted and striped at birth, like those of the lion, proves that the uniformly coloured coat is a later acquisition.

The small head, elegant in outline, is



To face page 176.

PLATE XI. — THE JAGUAR (*Felis onca*).

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

adorned with two splendid brightly gleaming eyes. Among all the mammals which I know the seal alone can vie with the puma in the beauty of this feature.

But the proud and gentle expression of this eye is deceptive. Wherever it is found (and its domain extends from Patagonia to Canada), the puma has the reputation of being a cruel and cowardly beast. Its size, which is upwards of four feet, would enable it to attack the largest tame and wild animals of America; but it leaves the horses, mules, and oxen unmolested, flees before dogs and man, while it eagerly attacks sheep and goats, as well as monkeys, peccaries, armadillos, and all mammals, birds, reptiles, and fish of comparatively small size. Like all felines, it prefers cautiously to slink up to its victim and surprise it with a bound, but it pursues even the agile monkeys on the trees with enormous and well-calculated leaps. Every kind of habitat is alike to the puma if only it can find a safe retreat to rest in. The treeless Pampas please it just as well as the tumbled rocks of the mountains or the primeval forests. It swims across rivers, and climbs to the highest tree-tops with the greatest ease.

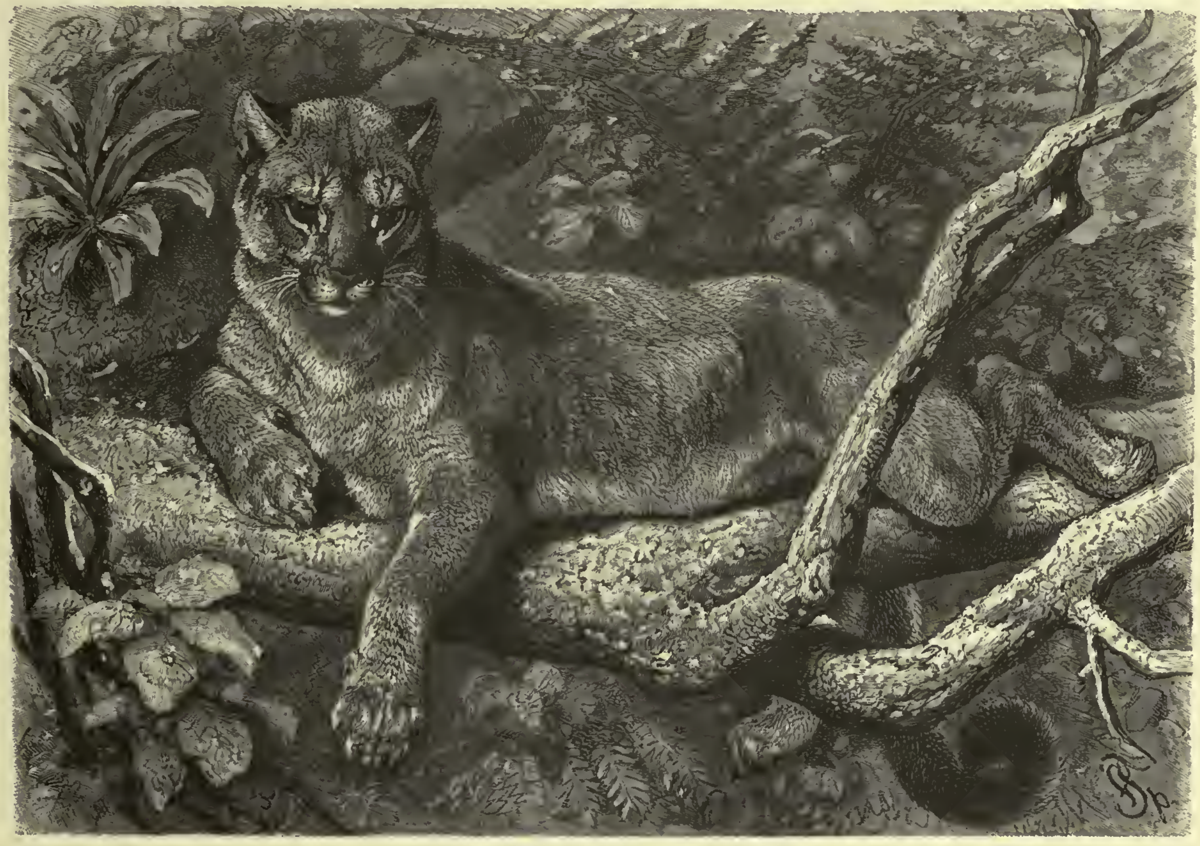


Fig. 81.—The Puma or Cougar (*Felis concolor*).

The ravages which the puma commits among the flocks have made him detested everywhere. The jaguar kills only a single animal, if it suffices to satisfy his hunger; but the puma flies at the throat of an animal, and sucks its blood without touching its flesh. Pumas have been killed after they had slaughtered twenty sheep immediately before, and their stomachs have been found to contain nothing but coagulated blood. One can therefore easily understand that such butcheries must cause the ravager to be pursued with untiring zeal and bitter hatred, and the pursuit is all the easier since the animal may be attacked without fear. In the Pampas the Gauchos strangle him as they do the jaguar; in the forests he is hunted with a couple of dogs, on seeing which he immediately takes to a tree, whence he observes for an instant his barking foes. If the hunter is not quickly at hand with his missiles, the animal escapes with rapid leaps from branch to branch. Dogs fall upon him with fury, while they fear the jaguar, and only bark at him. It need hardly be mentioned that for his extirpation one has recourse to snares, traps, poisoned arrows, &c., and that he is fearlessly attacked with a naked weapon. The Indians eat his firm white flesh, which is said to resemble veal.

Shy and timid the puma is easily tamed, and behaves in captivity like a gently-disposed cat, though it often becomes an unpleasant companion through the violence of its caresses. But in the settlements it is difficult to train it to spare tame poultry. Its innate thirst for blood often causes it to deviate from the paths of a hardly acquired virtue.

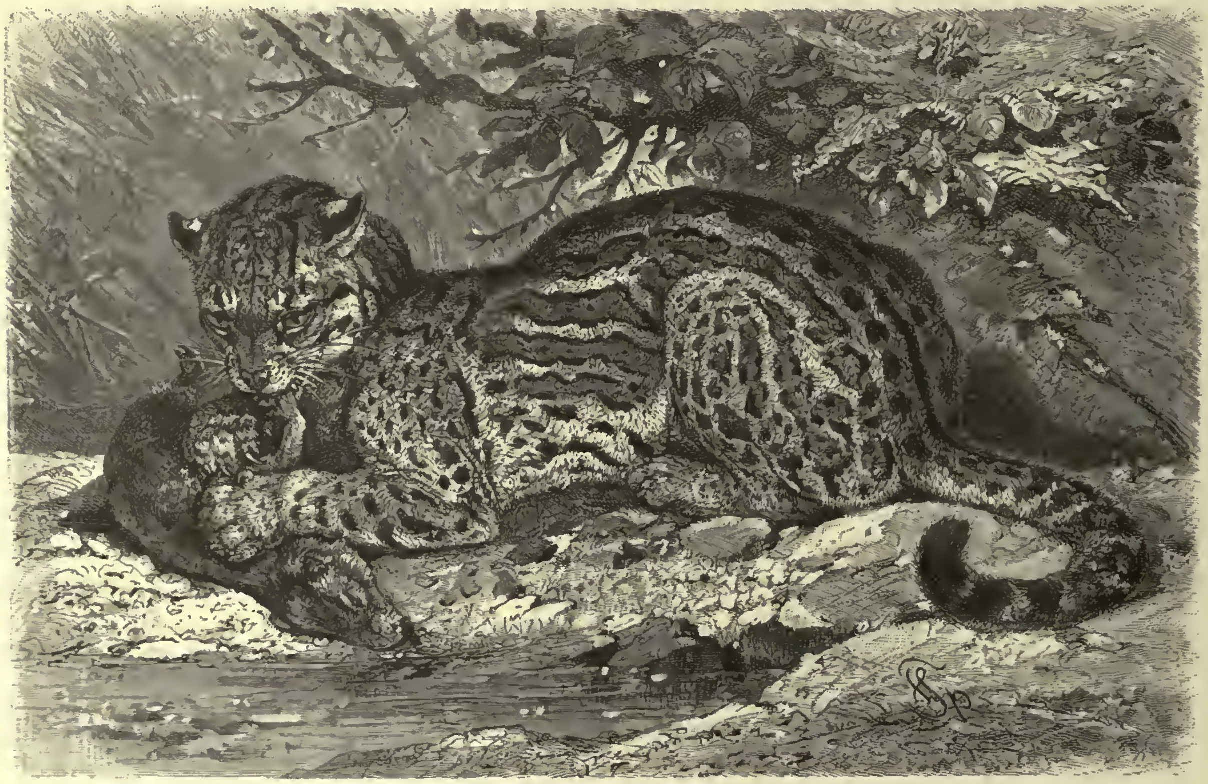


Fig. 82.—The Ocelot (*Felis pardalis*).

The following narrative by Lady Florence Dixie shows the terror which the puma inspires in mules and horses:—

"As we were approaching the spot where we intended camping, one of the mules, which was heading the troop, suddenly turned and dashed away, and in another instant the whole troop broke up and dispersed, galloping in all directions. What was the cause of this stampede? We pressed quickly forward, but nothing stirred in the long grass, though we scoured everywhere. We were baffled for a minute. 'It's a puma somewhere,' said Gregorio. The words were hardly out of his mouth when a loud view-holloa rent the air. 'There he goes, there he goes!' shouted two or three of our party in chorus, and sure enough, there he was going—a mighty yellow puma—slouching swiftly away at some distance to our left, with my brother following close on his track. For us all to gallop after and come within ten yards of the puma was the work of a moment, but to get nearer than ten yards or so was quite another matter, as our horses were quivering with fright, and with difficulty were kept from turning tail and bolting from the dread presence of their mortal enemy. Meanwhile the puma, finding himself surrounded, lay sullenly down, eyeing us with dogged hate, and scarcely seeming to heed the presence of the dogs, who were growling furiously at him at a respectful distance from his claws. Finding it useless to try to approach on horseback, my brother dismounted, and a rifle being at hand, took steady aim at the crouching animal and fired. Simultaneous with the report, with outstretched paws and a deep growl, the puma sprang forward, and then fell heavily to the ground, whilst our horses, becoming wholly unmanageable, reared up and fairly bolted. When we again got control of them, nothing would induce them to return to the spot where the now lifeless body of the puma lay, and we had to dismount and walk there. Very fierce and dangerous it looked; and at the sight of its ponderous paws with their sharp talons and its cruel white teeth, we wondered whether, if it knew its own powers, the puma would be such a cowardly animal as it is. They scarcely ever attack man, even when brought to bay, but lie down and doggedly meet their fate, though they can kill a full-grown guanaco with one blow of the paw, and pull down a horse with similar ease."—*Across Patagonia.*

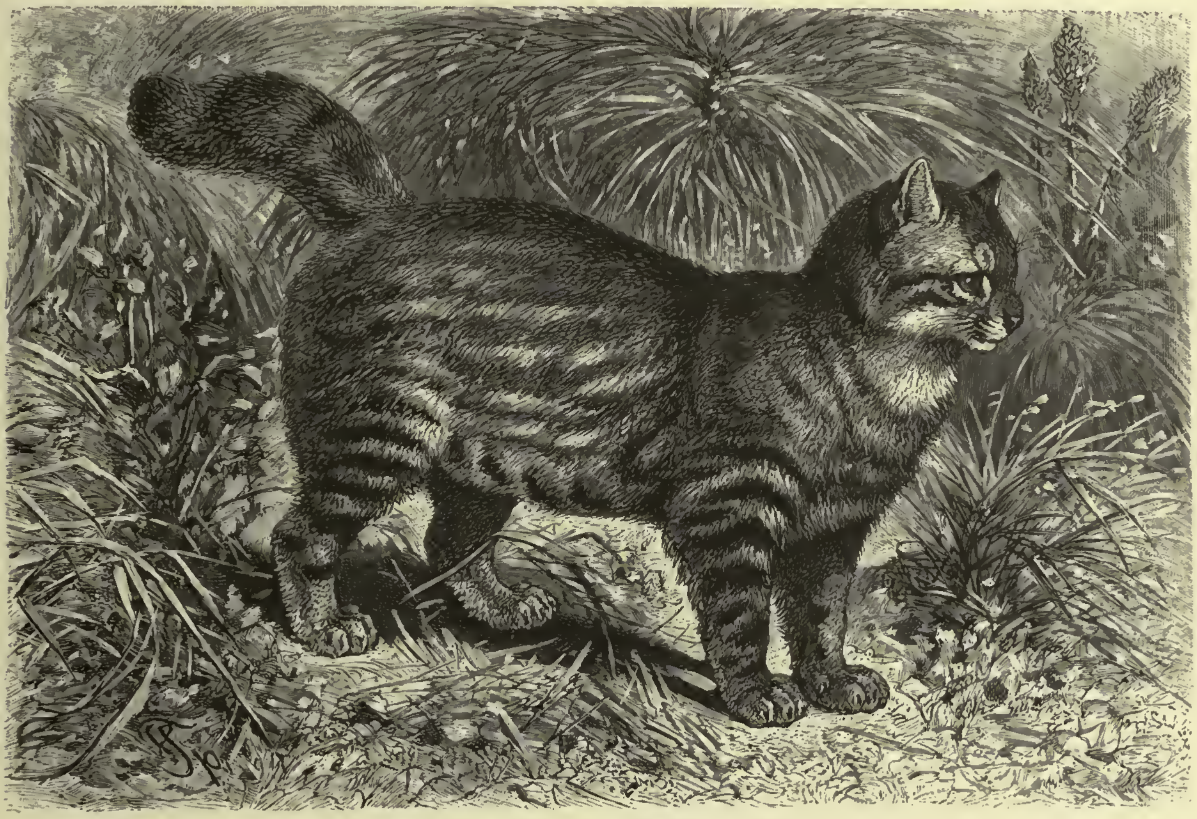


Fig. 83.—The Pampas Cat (*Felis pajeros*). page 180.

The **Ocelot** (*Felis pardalis*), fig. 82, corresponds somewhat in size and behaviour to the Clouded Tiger of the Old World. It attains a length of about 3 feet or more, while the tail measures about 18 inches. The ground colour of his fine soft fur is reddish yellow on the back, and yellowish white beneath. The head and neck show dark longitudinal stripes, the tail black transverse stripes. The paws are spotted, and on the sides a few large ring-shaped brown spots are visible, and these inclose a lighter-coloured centre marked with a few black spots of minute size, but sometimes they run together so as to form longitudinal stripes. The ocelot inhabits almost the same regions as the puma, but prefers to frequent the great forests, whence it makes excursions into the neighbouring farmyards and villages. Its food appears to consist mainly of birds and rodents.

What may, perhaps, be said to distinguish it from the other felines is the fact that the male is nearly always accompanied by the female. Its life is in other respects the same as that of the puma. It fears dogs and men, does not attack large animals, and like the puma leads a wandering life. It is said to be less bloodthirsty than the puma, and it is hunted rather for its fine fur than on account of the damage it does.

LIBRARY OF THE UNIVERSITY OF

The **Pampas Cat** (*Felis pajeros*), fig. 83, represents our wild cat throughout Patagonia as far as the Straits of Magellan. The silver-gray ground colour marked with rusty red spots and stripes gives to its coat a noble and somewhat distinguished appearance. On the sides and neck the spots run together into longitudinal stripes. This beautiful cat lives chiefly in the Pampas far from the forests, feeds on birds and burrowing rodents, and appears to have a very gentle and agreeable disposition. It might, perhaps, be reared in Europe. The Gauchos let it alone, for it renders them good service in destroying the rodents which dig out the ground underneath their horses' feet and thus cause them to stumble.

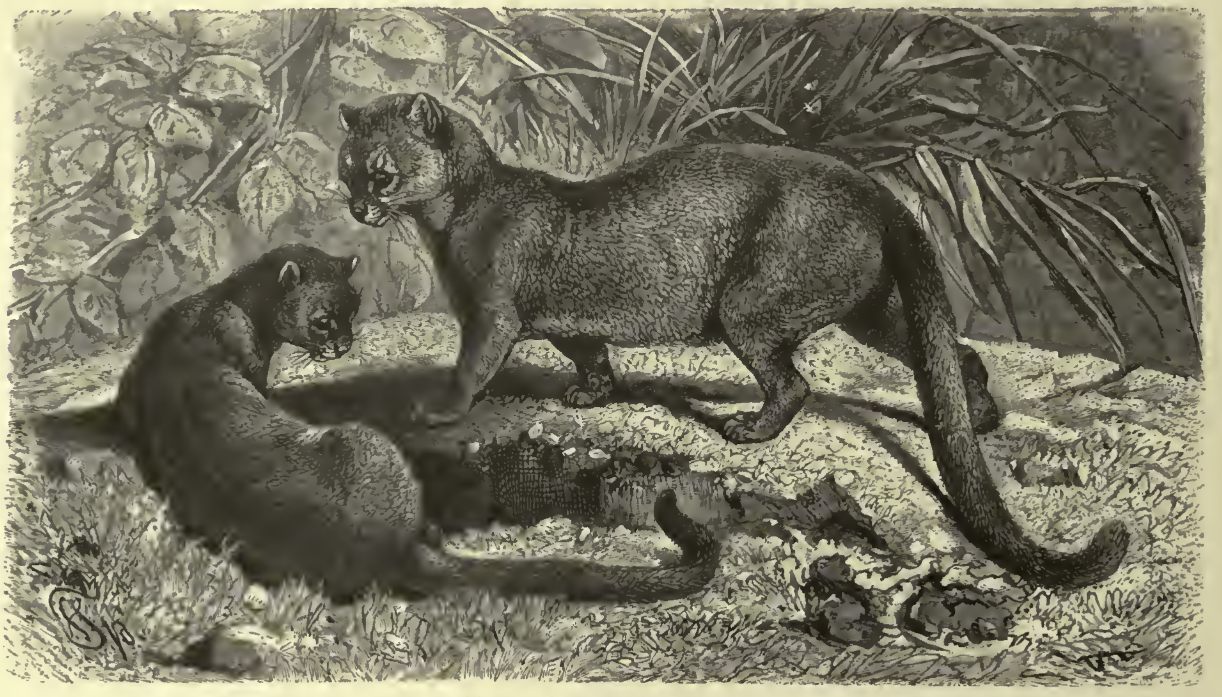


Fig. 84.—The Eyra (*Felis eyra*).

As the type of the American cats with longish worm-shaped body, an illustration is given of the Brazilian **Eyra** (*F. eyra*), fig 84. The body attains a length of rather more than 18 inches, while the tail measures from 12 to 16 inches. With its small head and long cylindrical body the eyra resembles at the first glance rather a weasel than a cat. The soft silky fur has a beautiful orange-yellow colour, and is without stripes or spots. A larger species, the **Jaguarondi** (*F. jaguarondi*), with a dark grayish-brown fur, takes the place of the eyra in the forests. Both species almost always hunt in pairs, prefer birds to mammals, do great damage in the poultry-yards, but also attack lambs and animals of the size of a roe-deer, are very adroit and wily, and are eagerly hunted by the inhabitants. No one has ever succeeded in taming either of them.

THE LYNXES.

(LYNX).

The group of the lynxes (genus Lynx) is distinguished from the other Felida not only by their short compact body, long legs, short, sometimes merely rudimentary, tail, and the tufts of stiff hair on the rather large pointed ears, but also by the fact of their having a more highly developed carnivorous dentition. The first premolar in the upper jaw in most cases remains undeveloped, or if it appears, it is deciduous and soon lost. The lynxes accordingly have two teeth fewer than the felines and hunting-leopards, and in respect of this reduced dentition approach the terrible extinct Machairodus, which may be taken as the type of the carnivores in the highest stage of their development.

The lynxes, of which we are acquainted with about a dozen species, are distributed over the whole of the mainland of the Old World, but in the New World advance southwards only as far as Mexico. They have not forced their way along the Isthmus of Panama, and are entirely wanting in South America. On the other hand, lynxes are found in the burning deserts of Africa and Asia, but it may probably be said that these beautiful creatures thrive best in the Polar regions and among the mountains of the temperate zone. The **Booted Lynx** (*L. caligatus*) of the warm regions of the Old World scarcely exceeds in size our wild cat, while the lynxes of the high latitudes of Norway and Canada are not much inferior to the panther.

The characters which we have mentioned above are indeed always very well marked, but not always developed in the same degree.

The tail of the booted lynx is longer, its legs shorter than in the other species; in its general aspect it approaches more closely to the felines than the others do. The fur also presents certain differences with regard to the development of certain parts. The winter coats of the lynxes of the far north command good prices. They are, indeed, somewhat coarse and easily torn; but on the other hand, are thick, warm, and brightly coloured, and therefore much sought after for coarse furs, while those of the southern species are so thinly clad with hair that they do not appear in the market at all. In most cases the face of the lynx is bordered by large long glossy whiskers, which leave the chin free and end in two points, something like the whiskers of the saints in the old Byzantine pictures; but it is again the northern species that have the whiskers longest and bushiest. The paws of the southern species are thin and narrow; those of the Polar forms, on the other hand, broad and powerful.

In their general habits of life the lynxes do indeed manifest the characteristic stamp of the feline nature, but they, nevertheless, exhibit certain peculiarities. They hunt by night, and cower by day in carefully chosen retreats; but they often hunt in pairs, and not infrequently in more numerous bands. If in some cases they confine themselves to a single great leap in making an attack upon an intended victim, they can nevertheless, thanks to their long legs, pursue their game running, and when the first leap has been a failure they do not turn back ashamed, but make several leaps in succession. They prefer to remain within a limited district when they can find enough food, go out upon their hunting expeditions with great regularity, and when they hunt in company follow their own trail so well, each of the hinder ones always treading in the footsteps of the one in front, that from the track alone a hunter can never tell how many of these animals have passed. All the wiles of the other members of the cat tribe are known to them, and they also are guided by a remarkably acute sense of hearing. We speak of "lynx-eyes" when we mean to indicate an unusual keenness of vision, but all modern observers are agreed that, as regards this sense, the lynx does not surpass the other members of the family to which it belongs. Courageous, fierce, and wily, the lynx lives at the expense of all animals which it can destroy. Large game is preferred to small. But necessity knows no law. The northern lynxes slay the elk and the stag, but do not despise either the hare, the partridge, or the duck. If there is excess of food they kill only to lap up the blood. When we think of the ravages committed, for example, in the Alps, by the few lynxes to be found here and there, constantly exposed to pursuit, we might almost believe that the fierce animals were driven by fury and despair to manifestly useless butcheries.

The chase of the lynx is difficult and

laborious, but not very dangerous. In general it tries to get out of the way of men and dogs, while it has a peculiar hankering after cats. But when driven into a corner, hotly pursued or wounded, it does battle for itself spiritedly, and woe to the dog which it can manage to reach with its terrible claws! And this need not excite wonder. One ought to be very careful in approaching a wounded wild cat; how much more so then in approaching a lynx, which is infinitely stronger than a cat!

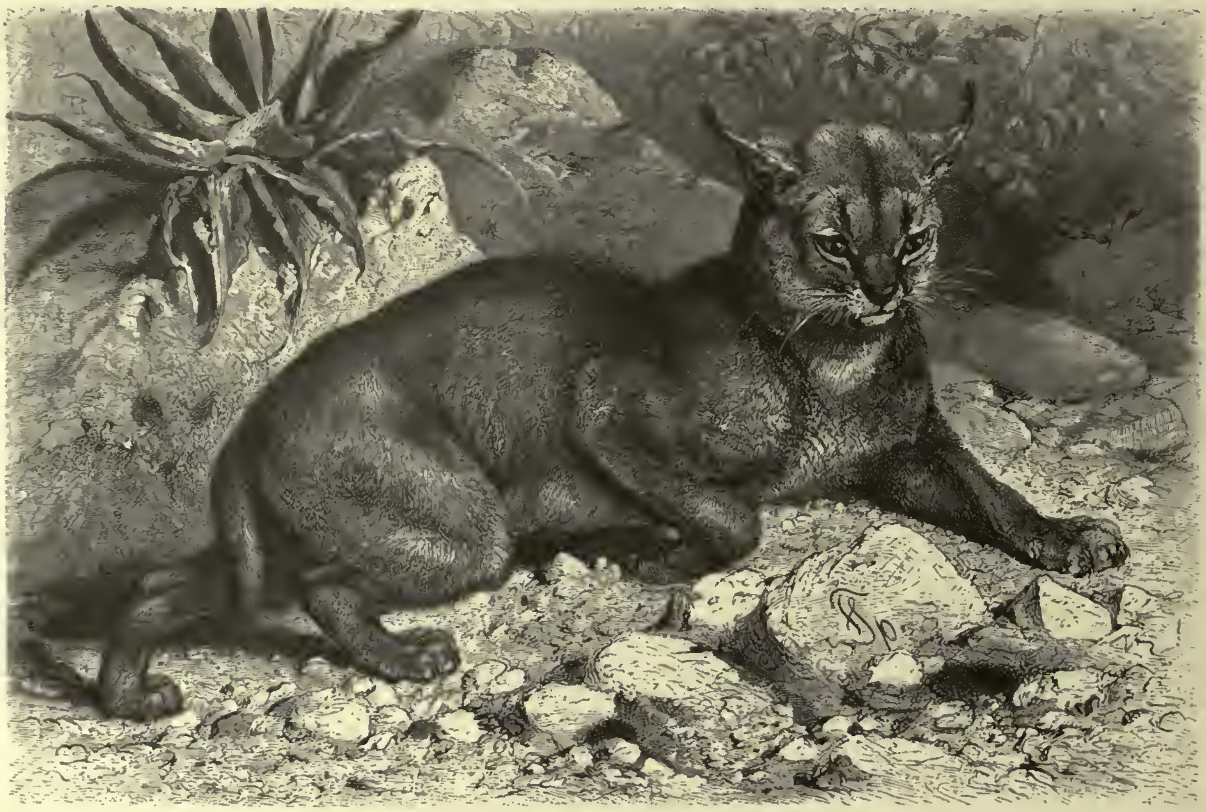


Fig. 85.—The Caracal (*Lynx Caracal*).

An illustration is furnished of the **Caracal** (*L. Caracal*), fig. 85, as representing the lynxes of the south. Its very long legs, its slender and almost lean body, and its uniform reddish-yellow coat proclaim it at the first glance to be an inhabitant of the desert. The colour varies more or less from yellow to brown or brownish-red, but always seems to be wonderfully adapted to the districts which it inhabits. Where there are no fragments of rock, fissures, and caves, then pistachios and myrtle bushes or the tufts of the alfa-grass afford the caracal secure retreats in which it may cower by day. In Algeria it is almost extirpated. In the Sahara it is detested as the ravager of the poultry-yards and the dangerous enemy of the watch-dogs. It has never yet been tamed.

Europe supports two species of lynxes. The stronger of the two, the **Polar Lynx** (*L. vulgaris*), fig. 86, was formerly spread over all Germany and France as far as the Alps and the Pyrenees, and to be found in forests everywhere. At the present day lynxes are a great rarity in the Alps, the Ardennes, and even the Bohemian forest, while Norway, Sweden, and the whole of the eastern part of our continent still harbour a pretty large number of them. Only on one occasion in the course of my numerous residences in the High Alps, one night during a terrible snowstorm, did I hear the strong harsh voice of the lynx in the neighbourhood of my tent, which was erected on the Aar Glacier. The next morning we could follow its track across the glacier, and two days later we heard that a wild animal, probably a lynx, had destroyed some sheep in a pen forty or fifty miles off. In the north the lynx is generally found in the forests, where it sits crouching on the branch of some tree on the watch for passing game.

In winter, when snow is on the ground, it is fond of pursuing hares, making while doing so a series of astonishing leaps. It is caught in traps, and is hunted, sometimes by large parties, sometimes singly, with the aid of a good greyhound, both on account of the damage it does and also for the sake of its fur. The hunting parties usually endeavour to surround the object of pursuit so that it cannot escape. The colour of its coat varies very much, passing from red or yellowish-brown with irregular spots in summer to silver-gray for the ground-colour in winter. But one may say with truth that there is no lynx which exactly resembles another. The Canadian lynx is only a variety of the European, but is distinguished by its longer and thicker fur, which is very valuable.

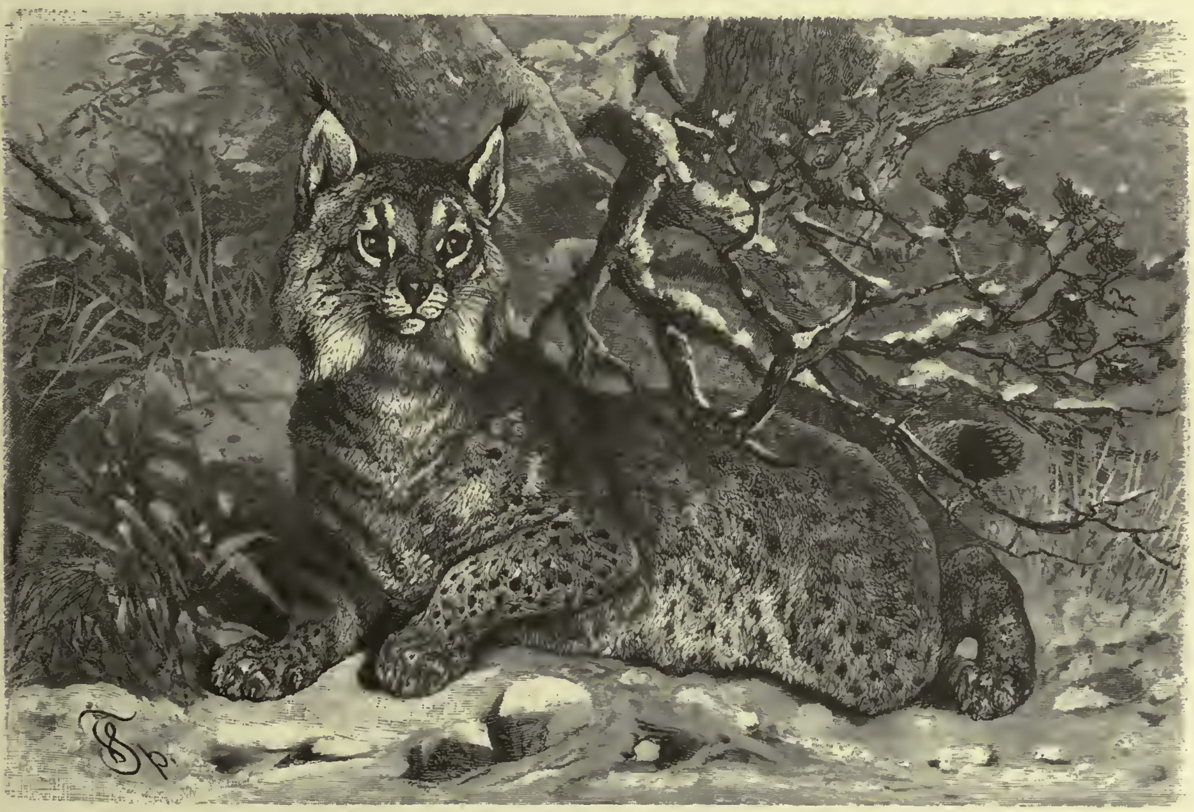


Fig. 86.—The Polar Lynx (*Lynx vulgaris*).

Some examples are known of tamed lynxes which become just as gentle and obedient as the best trained cats. But these cases are rare, and the lynxes kept in cages are in general very uninteresting. They remain motionless for hours, show a little animation only when something is given them to eat, and pay very little attention to what goes on round about them.

The **Spanish Lynx** (*L.* (*Felis*) *pardinus*), fig. 87, is unmistakably a distinct species. It is found throughout the Iberian Peninsula and nowhere else. Weaker and longer in the legs than the other European species, the Spanish lynx has a coat of a yellowish-red colour, with small irregularly scattered spots on it, and faint longitudinal stripes on the head; its whiskers are very insignificant, and its tail very short. It lives in the same manner as the northern lynx, and even ventures near towns. Its flesh is highly esteemed as a dainty by the Spaniards; and in the middle ages that of the northern lynx also was considered to make an excellent roast. This is rather a noticeable fact, seeing that the flesh of beasts of prey in general, notwithstanding its beautiful white colour, is rendered by its toughness not very appetizing.

The Fossa.—We introduce here a very remarkable animal which is found only in Madagascar, and which may be described as a Tertiary feline whose existence has been continued to the present day. It is the **Fossa** of the Malagasies, or, in scientific nomenclature, *Cryptoprocta ferox* (fig. 88).

I have called the fossa a Tertiary feline, and we must actually go back to the Eocene formations in order to meet with another dentition of the kind. In the upper and under jaw there are six incisors as in all Carnivora; but in the upper jaw the two inner pairs are very small with narrow crowns, while the outer pair are much larger, and have each the form of a truncated cone. The canines are short, thick, not very sharp at the edges, like the canines of certain bears. After the canines there follow on each side four premolars, the first very small, deciduous; the second with two roots; the third larger than the first two, with a posterior heel and an internal marginal tubercle; while the fourth is the carnassial, with two very sharp cusps and an internal process in front. A very small transversely placed tubercled tooth comes close behind the posterior cusp of the carnassial. If the supernumerary deciduous premolar is left out of account, the dentition of the upper jaw is that of a feline of the present day. The lower jaw has very strong curved canines, and behind these the same number of premolars as the upper jaw (four on each side), the first again deciduous, the others increasing in size from before backwards, with sharp median cusps, and finally a carnassial with two sharp cusps and a posterior heel.

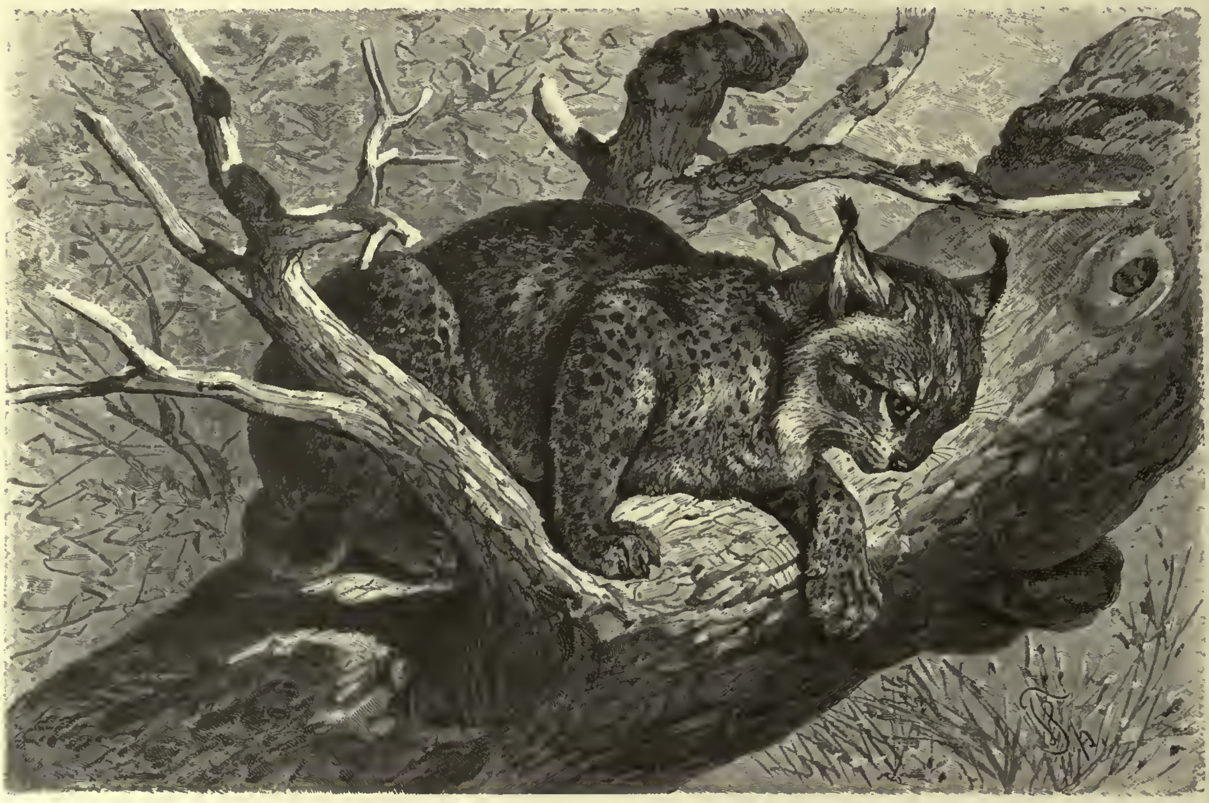


Fig. 87.—The Spanish Lynx (*Lynx pardinus*). page 183.

This lower jaw is no longer than that of a feline, for it has two premolars in excess. But the form and position of the teeth are of such a nature that if the lower jaw were found by itself, and without its deciduous premolar, it would be included without further consideration in a fossil genus belonging to the Upper Eocene, which has long been known to palæontologists under the name of Pseudælurus. The formula of the two genera is certainly different. Pseudælurus has only 32 teeth, while the fossa has 36. But there are only slight differences in the forms of the teeth. The fossil species have also been called "four-toothed cats," for all the other felines have only three molars in the lower jaw. The fossa would accordingly be a five-toothed cat.

But here end the characters which the fossa has in common with the other felines, and with them alone. With respect to its other characters the fossa is allied partly to the felines, partly to the Viverrida, or to the latter alone.

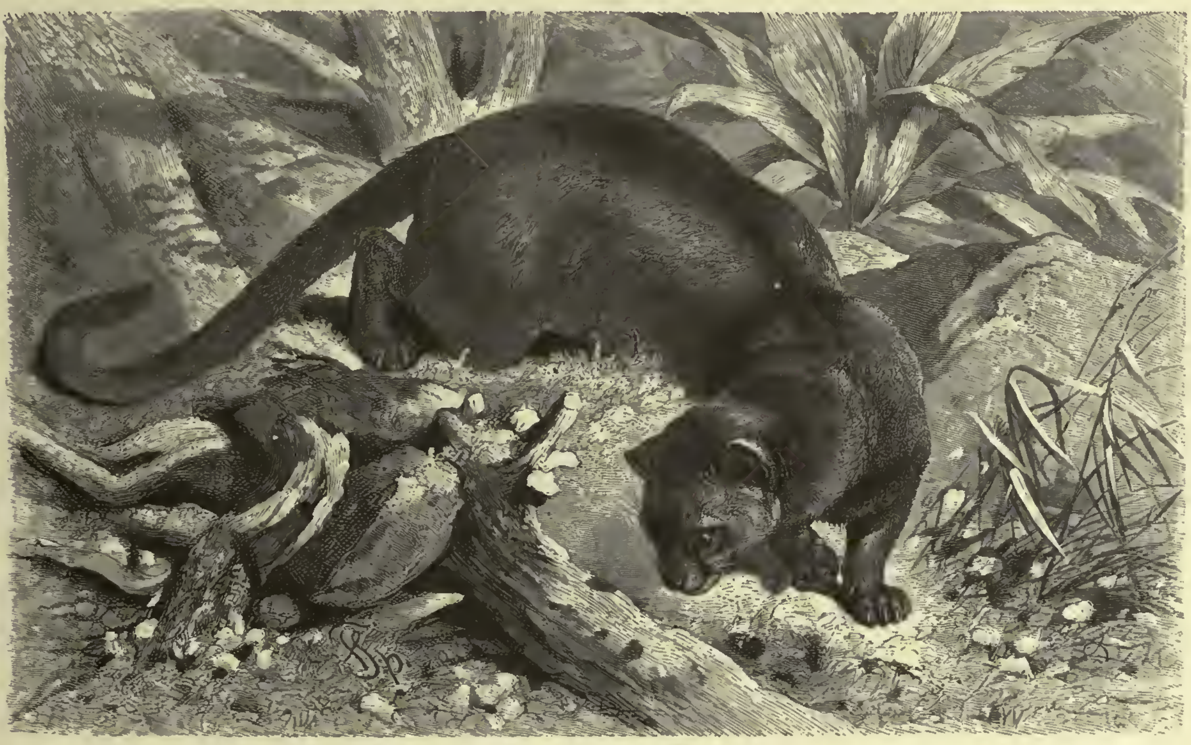


Fig. 88.—The Fossa (*Cryptoprocta ferox*).

The claws are retractile, as in the felines and in many Viverrida. The fossa is manifestly plantigrade like certain Viverrida. The body is very long, the legs short, the ears small; the pupil is slit-like. All these characters, to which we must add the longish form of the skull with a well-developed sagittal crest, and the long jaws, are more like what we find in the civet-cats; and this relationship is further indicated by the naked soles and by the presence of a pair of scent-glands in the neighbourhood of the anus, diffusing a very unpleasant odour. Such glands, always developed in the civet-cats, are wanting in the felines.

We may thus describe the fossa as a civet-cat with a Tertiary feline dentition. It forms a connecting link between two families, which at the present day are strictly separate.

The fur is of a uniform reddish-yellow, inclining to brown on the back; the hair is smooth, closely pressed to the body, and coarse.

Since the fossa is the only beast of prey of considerable size in Madagascar (the few civet-cats which are found there attain only the length of the ermine, while the fossa measures about 2 feet 8 inches in length, not including the tail of about 2 feet 4 inches in length), it will not excite surprise that the Malagasies have an undue dread of it. It is a very ferocious nocturnal animal, which works great havoc in the poultry-yards, pursues the lemurs on the trees, and attacks even young pigs. It is comparatively easy to kill, since it is readily lured by the cry of a fastened hen. The natives eat its flesh, and, in spite of the diabolical stench which the animal diffuses, regard it as a dainty.

THE VIVERRINES

(VIVERRIDA).

Carnivora of small, or at most of moderate, size, with short legs, and two permanent molars in each half of each jaw.

This family, which is so strictly confined to the warm parts of the Old World that the most northerly species are not found to the north of the Mediterranean, presents rather variable characters.

The body is in most cases long, slender, and not powerfully built; the legs are always short; the tail is usually very long and bushy, but running to a point at the end. The head is small, the rather long snout always provided with very long whiskers. The brain-case is considerably prolonged towards the back of the skull, the orbits are often closed in the form of a ring, the zygomatic arches not very wide, and the muscular ridges poorly developed.

The family is divisible into two groups based on the structure of the feet, which have sometimes five, sometimes only four toes. In the one group, of which we may take the civet-cats as the type, the feet resemble those of the felines in structure; while in the other, the mangoustis, we may even observe a tendency to the structure seen in the bears. The civets are, in fact, digitigrade, their toes are connected at the base by a membrane, hairy below as well as above, and armed with retractile claws. The mangoustis, on the contrary, are rather plantigrade, have pretty long toes, which are perfectly distinct, and with the claws non-retractile, so that they get worn away in walking. The soles of the feet are naked, or only slightly hairy.

The fur is sometimes fine and silky, sometimes long-haired and coarse. Dark colours, suitable to the generally nocturnal habits of the animals, prevail; yet stripes, spots, and confused markings, which, however, do not stand out very well from the dark ground, are often present.

The dentition of the Viverrida, while exhibiting a certain variability in the number of the teeth, presents forms which remind us of the insectivores, and even of certain marsupials, as in particular the rat kangaroos. The incisors and canines have the general characters of the carnivorous dentition, but the canines are often not very prominent or very strong.

The premolars, on the other hand, play an important rôle. They are strong, pointed, sometimes conical, sometimes flattened on the sides and with cutting edges, but never develop such strong secondary lobes as are met with in the other Carnivora. In the upper jaw the last premolar, as in all other carnivores, is the carnassial tooth, but it is very variable in its forms. Its crown scarcely ever rises above that of the premolar immediately preceding. When well developed this tooth shows a tendency to

UNIVERSITY OF CALIFORNIA

have its cusps of a sharp-pointed conical form, but in many cases it scarcely differs in form from the true molars which come after it. The latter usually have sharp-pointed cusps on the outer edge, and are prolonged into a narrow internal heel in such a manner as to assume exactly the characteristic form of the teeth of the Insectivora, so that one could not tell their origin if they were found singly. On the other hand, we observe in some genera a well-marked tendency in the dentition to become adapted to a mixed diet. The crowns then become broad, almost quadrangular, the tubercles become blunt and get so worn away that in the latter years of the animal's life they present to view almost even surfaces.

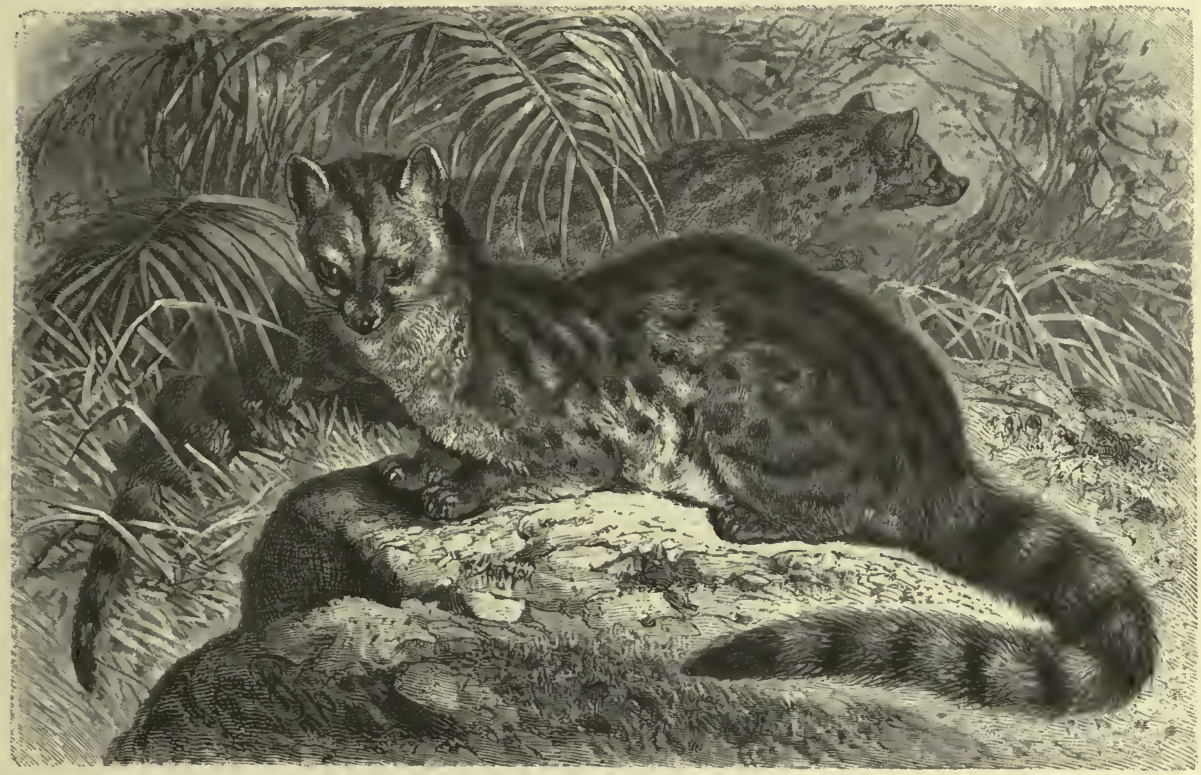


Fig. 89.—The Common Genet (*Genetta vulgaris*). page 188.

The tendency to a progressive specialization of the teeth is strikingly shown on a comparison of the milk with the permanent dentition of these animals. The premolars of the milk dentition are manifestly insectivore teeth, with sharp points which fit into those of the opposite jaw. I reckon with Owen three premolars above and below in the milk dentition of the suricate. The second deciduous premolar of the upper jaw has five sharp points, and by its form and size plays the part of a carnassial; the third has only three points, and resembles a permanent molar. Now in the permanent dentition the large five-pointed tooth is replaced by a conical tooth, and it is the last of the second set of teeth which becomes the permanent carnassial. The same thing happens in the lower jaw. The last premolar is, in the milk dentition, a carnassial with points; but in the permanent dentition it is replaced by a simple conical tooth, and the first permanent molar becomes the carnassial.

The total number of the teeth in the permanent dentition varies according to the development of the premolars. There are always two true molars in each half of the jaw, but there may be three or four premolars. The formulas of the permanent dentition are thus: $\frac{3 \cdot 1 \cdot 3 \cdot 2}{3 \cdot 1 \cdot 3 \cdot 2} = 36$, or $\frac{3 \cdot 1 \cdot 4 \cdot 2}{3 \cdot 1 \cdot 4 \cdot 2} = 40$. The species which have been examined with reference to their milk dentition all belong to the less numerous group comprising the genera with 36 permanent teeth, their formula consequently is $\frac{3 \cdot 1 \cdot 3}{3 \cdot 1 \cdot 3} = 28$. The same process which we have already observed in other families goes on here also; the carnassial moves in a measure backwards at the change of the teeth.

All these animals diffuse a penetrating musk odour, which is due to a secretion formed in well-developed anal glands. In the true civets these glands are inclosed in pretty large-sized pouches of a peculiar form.

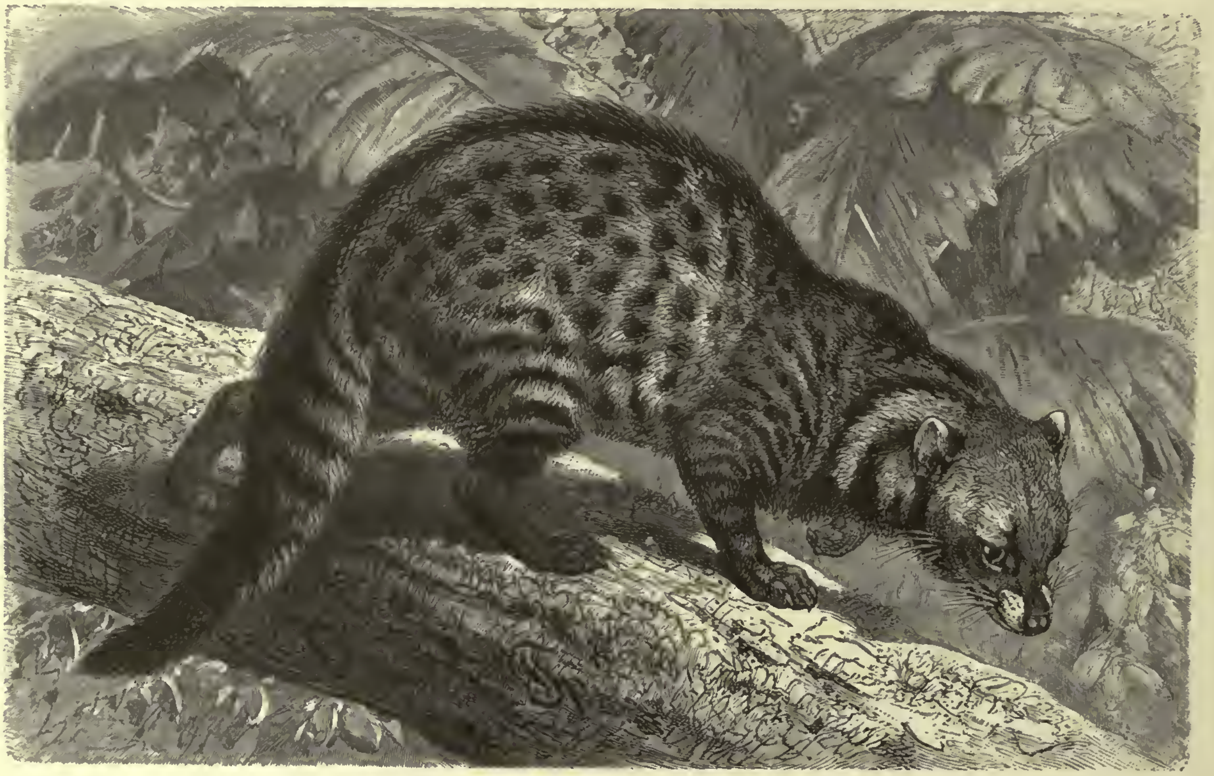


Fig. 90.—The African Civet-cat (*Viverra Civetta*).

The mode of life of the Viverrida is very varied. Some are nocturnal animals, while others hunt only by day. Some run and chase their prey like dogs, others slink up to it and seize it with a spring like cats. Many are expert climbers, others prefer the dry bare soil of the steppes. The great majority are exclusively carnivorous in their diet, but some live chiefly on fruits. Certain species can easily be tamed, and these render the same services as cats, ridding houses of mice; others, again, always remain wild and warlike even against their own kind.

The genera and species are very numerous. We select from the number only a few representatives of the two groups that we have indicated.

THE CIVETS

(AILUROPODA).

Digitigrade viverrines with retractile claws.

The **Common Genet** (*Genetta vulgaris*), fig. 89, is the sole representative of this group in Europe. It is met with throughout the whole of the maritime districts of the western half of the Mediterranean—in Southern France, Spain, Morocco, and Algeria north of the Atlas. It prefers rocky slopes overgrown with broom and pistachio shrubs to dense woods, but climbs pretty well; and feeds on birds, rats, mice, and, in case of necessity, even on insects.

It is a pretty animal, with a body measuring about 20 and a tail of about 16 inches in length. The ground-colour of its coat is a yellowish-gray, with marbled patches of black; the short, sharp-pointed head shows some longitudinal stripes; the pointed tail is ringed, the ears are pretty broad but short, the pupils have vertical slits, the very short feet have five toes armed with retractile claws. The genet has in all 42 teeth. The molars have several cusps, the upper carnassial is oblique and sharp. The premolars have only a single sharp lobe; the canines are sharp and recurved. The musk-pouch on the hip is not very deep.

The genet is nocturnal in its habits, but by day does not sleep so soundly that it is not awakened by the approach of an enemy or the passing of its prey. Unparaleled is the suppleness and flexibility with which it crawls on its belly like a serpent in order to surprise a victim, which it finally seizes with a spring. In dodging and gliding it is a true artist, and indeed an elegant artist, and, thanks to the facility with which it can insinuate itself through the narrowest openings, it is a pretty dangerous enemy for the poultry-yards. There it behaves like the marten, slaughtering all the fowls it can catch. In spite of these depredations it is not very fiercely pursued, for it renders good service by the destruction of noxious rodents, and, if we leave out of account occasional outbreaks of bloodthirstiness, it manifests on the whole a gentle and agreeable disposition, and can even be so far tamed as to respect the poultry-yard of its master. It is pretty frequently kept in certain districts as a domestic animal in place of the cat. Its strong musk odour, however, does not make it welcome to every one. It is often hunted for its fur; but not much is known about its general mode of life in a free state.

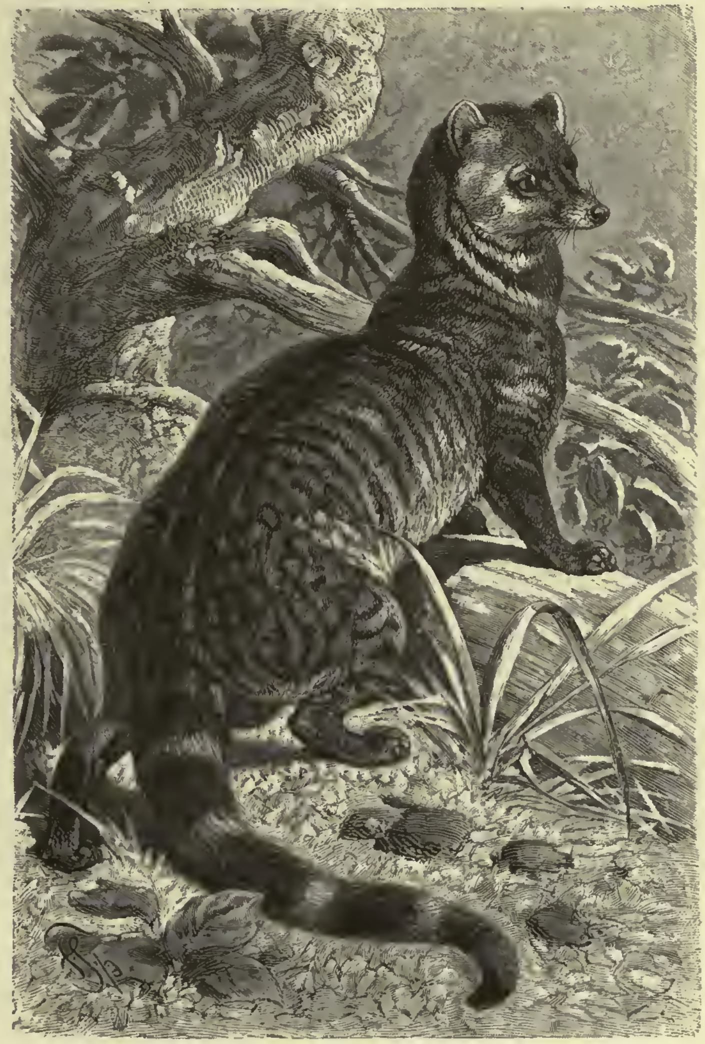


Fig. 91.—The Asiatic or Indian Civet (*Viverra Zibetha*).

Two species of **Civet-cats**, the African civet (*Viverra Civetta*), fig. 90, and the Asiatic or Indian civet (*V. Zibetha*), fig. 91, have acquired a certain reputation through yielding a fragrant substance known as civet, which is still prized in the East, and was formerly much used in medicine. Now the use of this scent with us is confined to the perfumer, and even with him it is getting more and more replaced by true musk derived from the musk-deer. In front of the anus, but in its immediate vicinity, there is found in the civet-cats a longish slit which leads into a wide pouch divided by a partition into two hairy pockets, into which open a large number of glands secreting a sort of wax like that which is formed in the ears. These pouches are present in both sexes. In certain districts in Africa as well as in India a large number of these animals are often kept in cages for the sake of the civet, which is still sold at high prices. When caught young these creatures can be tamed, but adult civet-cats can at most be trained to present their pouch between the bars of the cage so as to allow of the precious contents being extracted with a spoon. The fragrant matter is then well mixed with oil and inclosed in small tin boxes, the lids of which are afterwards secured by solder. The animals are fed with fresh meat, chiefly that of birds, which they prefer to any other kind of food. The better the civet-cat is fed the more civet does it yield. The smell pollutes the whole neighbourhood. To carry on such a business one would really need to have no nose at all!

The two species are pretty like one another. The African civet attains the size of a fox, the Indian is smaller. The fur is coarse and thick. A sort of mane which the creature can erect extends along the whole of the back as far as the long bushy tail. The ground-colour in the African species is yellowish-gray, and the adornment is in the form of irregular dark brown patches. The Indian species has a longer and leaner body. The patches unite into stripes, and the ground-colour is brownish. Both species sleep during the day, by night they hunt after birds. They are said to be peculiarly fond of eggs, and to show great skill in searching out nests. But it must again be admitted that not much is known about their habits in a state of freedom. The African species is found throughout Central Africa, from Zanzibar to Guinea. The Indian species inhabits not only the mainland but also the islands, and the Malays have introduced it almost everywhere, even into the islands of the Pacific Ocean.

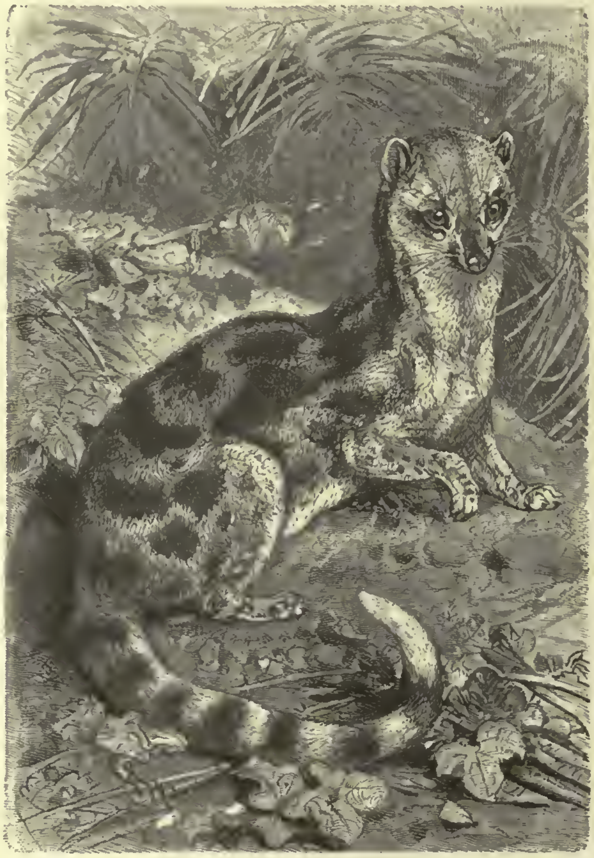


Fig. 92.—The Delundung or Linsang (*Prionodon gracilis*).

The slender **Delundung** or Linsang (*Prionodon gracilis*), fig. 92, exhibits a still more pronounced form of carnivorous dentition than the civet-cats. The last molar of the upper jaw is almost always absent; the other molars and the premolars have sharp points like those of an insectivore; the canines are slender, very sharp at the ends, and recurved. This wonderfully elegant little animal, whose body attains the length of about 16, and the tail about 12 inches, is even more slender and short-legged than the genet. The head is rather long, the snout pointed, the pupils vertical as in the cat tribe, the short smooth silky fur prettily marbled with dark brown patches on a yellow ground. The tail is ringed, and has a white point. The creature leads a nocturnal life in Java and the Malay Peninsula, and feeds almost exclusively on birds. The natives, who call it "the little tiger," both on account of the savageness of its disposition and the colour and markings of its coat, detest it as a bold and dexterous plunderer of the poultry-yard.

The **Paradoxures** or Musangs (*Paradoxurus*) manifest, in opposition to the previous species, a decided tendency to a vegetable diet in the structure of their blunt-tubercled molar teeth, which soon get worn down. This genus, which is very rich in species, has been subdivided into several sub-genera, founded on very unimportant distinctions. They are nocturnal animals, with pupils like cats, which they about equal in size. They approach the genets in the elongation of their powerful body, in the shortness of their legs, and in the form of the head. The tail, almost as long as the body, can be rolled up, but does not serve for a prehensile organ, as has sometimes been asserted. The feet have five toes, armed with pretty long but hardly retractile claws. In their mode of progression these animals are semi-plantigrade, and the musk-pouch exists only in the form of an open fold or fissure, in which lie the openings of the ducts leading from the glands, which excrete a substance like tallow, having a very disagreeable odour.

The paradoxures are capital climbers, and hunt principally after birds and birds' nests; but they also commit great ravages in the plantations, where they seek for sugary fruits, such as pine-apples and bananas, but still more for ripe coffee-beans. They eat the fleshy pods of the coffee-fruit and evacuate the undigested beans, which are searched for amidst their excrements under the pretext that they make the best coffee. But the yield from this source scarcely makes good the damage done by these animals, and the Javanese prefer to reap their coffee for themselves and to keep their fowls, rather than to pay with these the labour that the paradoxure performs in plundering their coffee-bushes. The numerous species are distributed through the East Indies, including the Sunda Islands. Fig. 93 represents the largest species of the genus, the **Common Paradoxure** or Palm-cat, the Coffee-cat of the Hindus (*Paradoxurus typus*), whose dark yellow coat is marked with black spots.

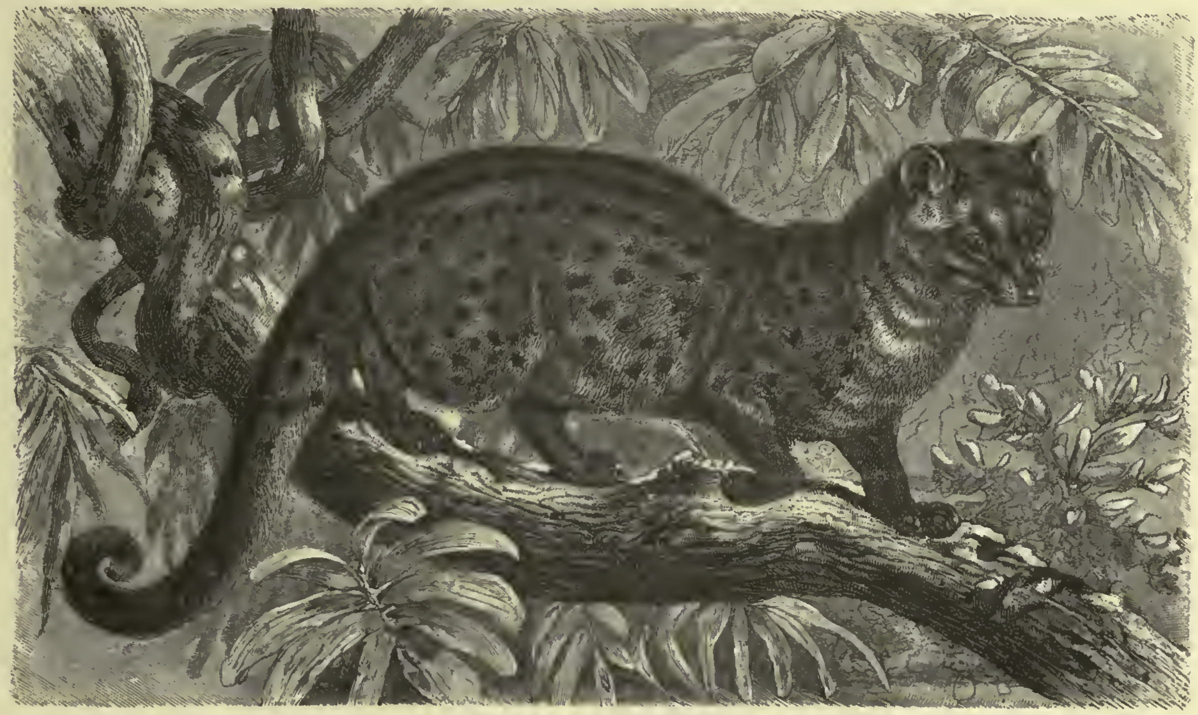


Fig. 93.—The Common Paradoxure or Palm-cat (*Paradoxurus typus*).

The **Mampalon** (*Cynogale Bennettii*), fig. 94, is the type of the aquatic forms among the Viverrida. The shape of the body is almost like that of a very long and powerfully built otter. The very short strong feet have five toes, which are webbed to the middle, and armed with strong curved non-retractile claws. The mampalon is semi-plantigrade. The sole of the foot is naked. The broad flattened head has very short external ears. The muzzle is broad and rounded, and has at the end slit-like nostrils, which can be closed when the animal dives. The cheeks and lips are furnished with enormously long whiskers, and there are similar long hairs above the eyes. These hairs are all strong bristles of a yellow colour, and impart quite a peculiar aspect to the face. The fur is smooth and thick, and intermingled with pretty long lustrous bristly hairs. It is of a dark-brown colour. The dentition is very remarkable. The canines are very strong, the premolars very sharp. The last upper premolar has something of the character of a carnassial tooth, but the two last molars both above and below have almost flat crowns with blunt tubercles. This structure is met with alike in the otters and in the fruit-eaters, and in the former it indicates a diet consisting mainly of crustaceans, mussels, and snails.

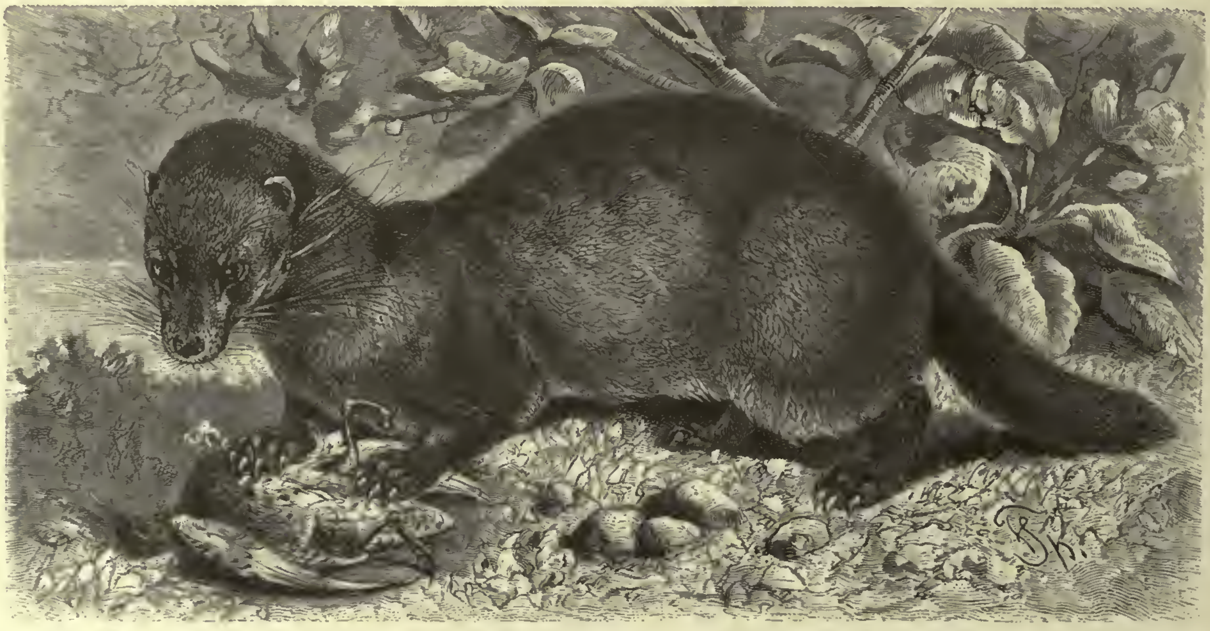


Fig. 94.—The Mampalon (*Cynogale Bennettii*). page 191.

The mampalon lives on the banks of lakes and rivers in the islands of Borneo and Sumatra. It feeds chiefly on fish and crabs; but it is said also to be a good climber, and to despise neither birds nor fruits.

THE MANGOUSTIS

(CYNOPODA).

With elongated toes, large non-retractile claws, and naked soles.

From this group, very rich in genera and species, we select only a few noteworthy representatives.

The **True Mangoustis** (*Herpestes*) may properly have a place assigned to them in advance of the other genera on account of the good reputation which some of them have acquired. They have a very long but strong and well-set body, a long pointed tail, short legs, feet with five toes, armed with very long, strong, curved, non-retractile claws. Some species, however, exhibit only four toes on the hind-feet. The features are round or broadly oval. The dentition indicates the carnivore. The canines are short, much curved, and very sharp; the premolars cutting, the carnassial pretty well developed, especially in the upper jaw; the molars with sharp points on the crown. There are usually 40 teeth in all, four premolars and two molars in each half of each jaw. But in some species the first premolar disappears early, so that the total amounts to only 36 teeth. The fur is always rough on account of the numerous bristles which project beyond a short wool, and often become so long that they entirely conceal the legs when the animal is creeping on the ground. Various species of these animals are found in all the warm parts of the Old World, and all hunt only by day, catching their prey alive.

Only one species (*H. Widdringtoni*) is found in Europe, in the south of Spain, and it is very little known. The hairs of this species are used in making paint-brushes for artists. That is all that is known about it.

The **Egyptian Ichneumon**, or Pharaoh's Rat, as it is sometimes called (*Herpestes Ichneumon*), fig. 95, is found especially in the Lower Nile Valley, but its domain extends into Palestine on the one hand, and as far as Tunis on the other. Among the twelve species of Herpestes native to Africa the Egyptian ichneumon is one of the largest, its body measuring about two feet in length, while the length of the tail is about 20 inches. The head is pointed, the ears short, the body pretty thick, the feet five-toed, the legs very short and almost hidden under the long hairs of the grayish-green fur, the colour of which is very well adapted to prevent the animal from being seen when it creeps according to its wont amidst the high grass and in the cane thickets. The long tail set with rather stiff bristles ends in a tuft which comes to a point.

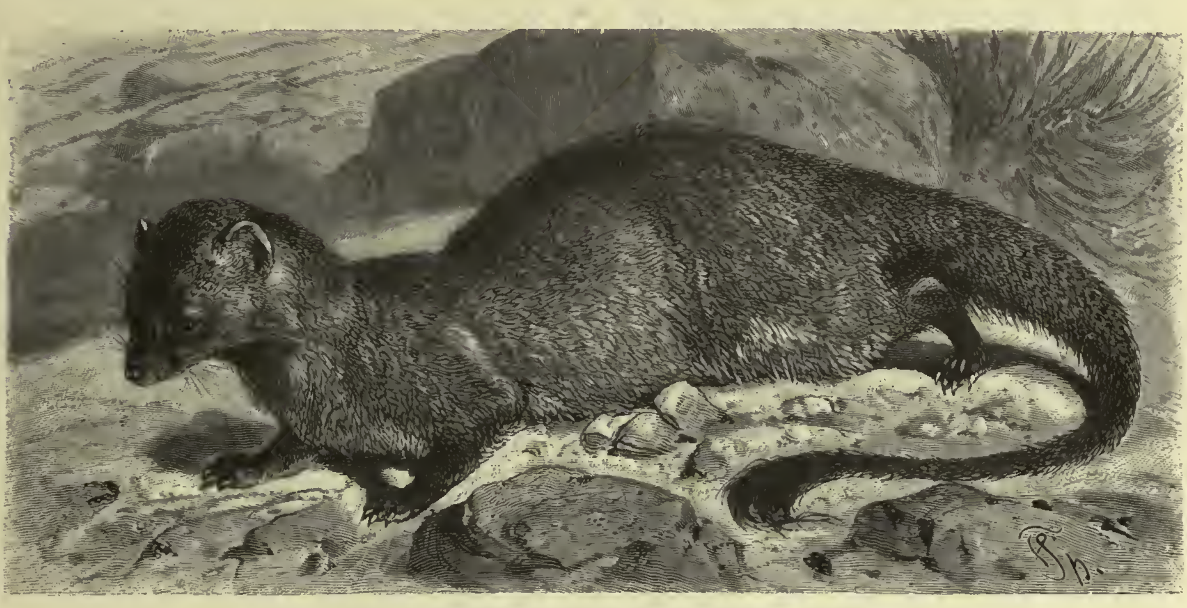


Fig. 95.—The Egyptian Ichneumon or Pharaoh's Rat (*Herpestes Ichneumon*).

The ancient Egyptians worshipped this ichneumon as a benefactor of the land. They saw in it the inexorable destroyer of the crocodile, and especially of the crocodile's eggs, as well as of dangerous poisonous serpents. Numerous ichneumon mummies are found in the graves. The most extraordinary deeds of heroism are related on the part of this animal. Not content with burrowing into the eggs of these terrible reptiles, the ichneumon was even said to steal into the open throat of sleeping crocodiles, to creep down to the stomach, and then to tear out the heart, and thus destroy the animal in a highly ingenious but cruel manner. If it met a large poisonous serpent, it was said to call its comrades to its aid in order to fight the terrible enemy in common. There was certainly much of the fabulous in these stories, but what we may accept as truth is that the ichneumon destroyed poisonous serpents and crocodiles' eggs. Since the crocodile has entirely disappeared from Lower Egypt, and the ichneumon accordingly can no longer render any services against it, the fellahs of the present day take chiefly into account the devastations which it commits in their poultry-yards, and pursue with an inexpiable hatred the creature that steals their fowls, ducks, and pigeons, and plunders the nests with their chickens and brood-hens. The Pharaoh's Rats are affectionate parents. The family, consisting of father, mother, and young ones, hunt during the summer in company, and while creeping amidst the grass keep so well together that one might fancy a large thick serpent was crawling about. The Egyptian ichneumon is often enough tamed, to serve as a means of ridding houses of all sorts of vermin. But it soon makes itself disagreeable by its smell, by the noise it makes, and by the ravages it commits among the poultry in spite of all taming.

The **Gray Ichneumon**, or Mongoose (*Herpestes griseus*), fig. 96, which occurs in India, measures only about 18 or 20 inches in length and has a silver-gray fur. Of a much more peaceable disposition than the Egyptian ichneumon, it can easily be rendered attached and confiding. It does not make much noise, keeps itself very clean, and renders the Hindus, who hold it in high esteem, important service through its untiring pursuit not only of rats and mice, but still more of serpents, which are so common in India. As regards the poisons of serpents it is gifted with the same insusceptibility to their action as the hedgehog, and it attacks with the most praiseworthy fury even the largest hooded snake. The battles which the mongoose wages against these terrible reptiles are as dramatic as those between the hedgehog and the viper, and the mongoose almost always comes out the victor. For the most part it manages to seize the serpent by the neck, and then to crush its head with a single powerful bite, after which it at once proceeds to devour it. Even when it has suffered a bite so that blood is drawn, and it is overmastered for an instant by the poison, the courageous animal does not allow itself to be deterred, and renews its attacks after a short rest, which it employs in eating some green herbs. The natives maintain that the mongoose knows antidotes among the native plants, but this is incorrect. On the contrary, it swallows the first green thing it can find, manifestly with the intention of producing vomiting, as dogs do. In the year 1871 an attempt was made to introduce the mongoose into the island of St. Lucia, one of the Lesser Antilles, which is infested by the terrible *fer-de-lance*, or lance-headed viper. A young mongoose killed one of these serpents after an obstinate struggle, in which its blood was drawn without its betraying any sign of being injuriously affected thereby. But it appears that the efforts to propagate this useful animal in the Antilles have not been successful.

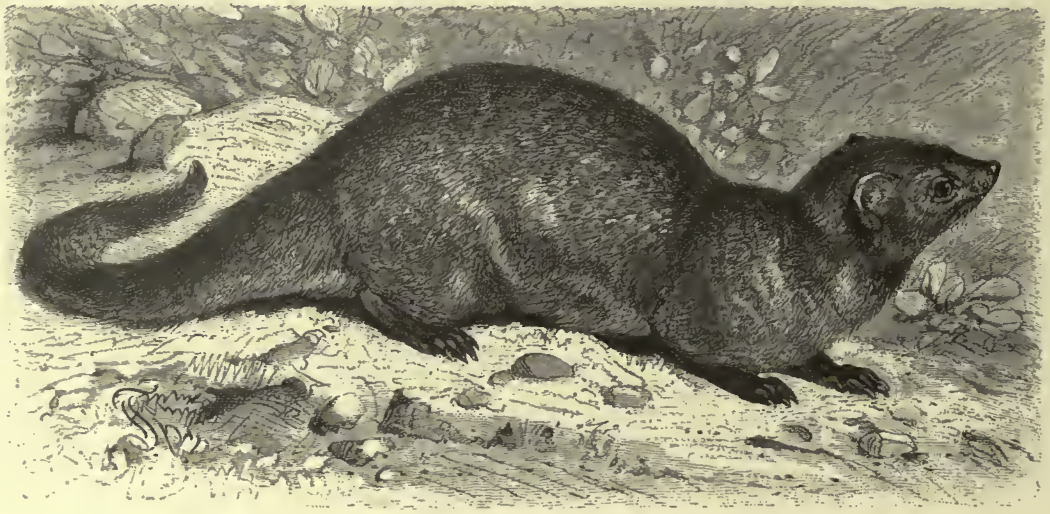


Fig. 96.—The Mongoose or Gray Ichneumon (*Herpestes griseus*).

In Jamaica great services have been rendered to the sugar-planters by the mongoose, which has been introduced into that island with great success as a means of destroying the rats (brown and black, but especially the "cane-piece rat") which do so much damage to the sugar-canes. Four males and five females were introduced direct from India in 1872, and since then they have multiplied enormously. As to the effect of this in diminishing the number of rats, Mr. D. Morris, writing to the *Field* from Jamaica on the 24th of Feb. 1882, says, "There can be no doubt that on sugar estates the mongoose has fully realized the hopes held out regarding its powers as a rat-catcher, and sugar-planters all over the island speak in the most unqualified terms of the good it has done in destroying the rapacious 'cane-piece rat,' and reducing the expense of rat-catching in all its phases." Several particular cases are adduced to show the extent to which this has been accomplished, and the writer concludes that "the annual saving to sugar estates by the introduction of the mongoose might very fairly be put down at 90 per cent of the rat-catching expenses, and at 75 to 80 per cent of rat-eaten canes."

A cut is also furnished illustrating the **Suricate** (*Rhyzæna* (*Suricata*) *tetradactyla*), fig. 97, which is easily distinguished by its very long slender head, feet with four toes armed with long curved non-retractile claws, and by its dentition. It has only three premolars and two molars in each jaw, which brings the total number of teeth to 36. All the teeth are very sharp and pointed, thus approaching the insectivorous type. This small animal (only a foot in length) inhabits South Africa from the equator to the Cape. It lives in underground dwellings, which it excavates with great celerity. The fur is gray and adorned on the back with ten transverse stripes. The tail, six inches in length, is round and thinly covered with hair.

The suricate goes sniffing about in all directions like an insectivore, and preys upon small mammals, birds, reptiles, and insects. It is easily tamed, and is kept in the huts of the natives as a domestic animal for the destruction of vermin; but the abominable stench which it diffuses from its anal glands, and its habit of excavating underground passages, make it tolerable only to the Kaffirs, who are accustomed to all sorts of bad smells from their youth up.

"As company for the monkeys and myself for many years past I have had a 'Jemmy.' All my suricates I call 'Jemmys.' The Latin name is *Suricata Zenick*. . . .

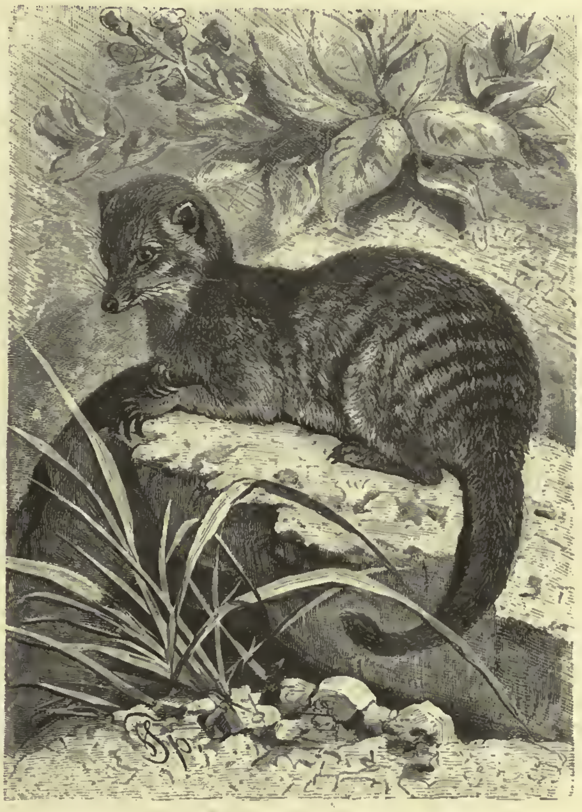


Fig. 97.—The Suricate (*Rhyzæna tetradactyla*).

"I should like now to say something of the habits of this pretty little fellow. Jemmy the Third (for I have previously had two Jemmys) was allowed the free range of the whole house. He was full of curiosity and restlessness, running continually from one room to another. He very seldom walked; his pace, on the contrary, was a short gallop, or rather canter. When on the move he always gave tongue like a hound on the scent. It was impossible to describe his melodious cry in words. When handled and petted he would utter a sharp bark, not unlike that of a dog, and if he was in a very good humour I could, by imitating him, make him bark alternately with myself. His great peculiarity was his wonderfully intelligent and observant look. He had the habit also of sitting up on his tail like a kangaroo: his fore-paws on this occasion were like a dog's when begging. He was very fond of warmth, and would sit up inside the fender and warm himself, occasionally leaning back against the fender and looking around with the satisfied air of an old gentleman reposing after dinner.

. . . . .

"One of the funniest scenes that ever happened with Jemmy was as follows. Some seaside specimens had been sent me, and among the seaweed was a live shore crab about the size of a five-shilling piece. Little Judy, the marmoset, who will eat any quantity of meal-worms, bluebottle flies, &c., came down at once off the mantel-piece and examined the crab, who was crawling about on the floor. None of my animals evidently had seen a live crab before. The monkeys were very frightened, and made the same cry of alarm as when I show them a snake or the house-broom. Judy plainly thought that the crab was a huge insect. The crab put out his two nippers at full length and gave the marmoset such a pinch that she retreated back again to the mantel-piece, and from this safe height gazed down upon the still threatening crab, uttering loud cries of 'Chich, chich, chich,' alternated with her plaintive, shrill, bat-like note. Presently round the corner comes Mrs. Cat. The cat evidently thought that the crab, that was gently crawling about, was a mouse. She instantly crouched, head, eyes, and ears all intent, as if trying to make up her mind whether the crab was a mouse on which she ought to pounce or not. Hearing the row caused by the crab and marmoset fight, up comes Jemmy in full cry, with tail cocked well in the air. He also attacked the crab, but could not make head or tail of him. He did not like the smell, still less did he like the sundry nips in the nose that he received from the crab's claws.

"A grand crab and Jemmy fight, which lasted nearly half an hour, then took place, ending in the discomfiture of the crab, whose carcass, when dead, the marmoset and the cat, both coming forward, evidently desired to share. Although it was apparent that the taste of the crab was not agreeable to Jemmy's palate, yet he gradually ate him up, claws, shell, and all, simply that the other animals should not get a single bit."—Frank Buckland, *Notes and Jottings from Animal Life.*

THE BEARS

(URSIDA).

Plantigrade carnivores, often with a plump and thickset body, with a degraded and often scarcely recognizable carnassial, and large tubercled teeth.

The characters of this large and very numerous family, which is distributed over all parts of the world inhabited by Carnivora generally, are not so clearly marked as might be supposed by those who are acquainted only with the bears usually kept in our menageries.

All bears are, indeed, unmistakably plantigrade, touching the ground with the naked sole of the foot throughout its whole length, but this character is found also in certain Viverrida and Mustelida, and consequently does not belong exclusively to the bears. The strong toes, usually five in number, are furnished in most species with large curved claws, which get worn away in walking, but there are also species in which these claws are more or less retractile. The body is mostly clumsy and thickset, but we also meet with elegant members of the group with long slender bodies. The tail, which in the large bears is very short and often a mere stump, is in other cases a genuine prehensile organ, like that of the American monkeys. With the exception of one species inhabiting the far north beyond the tree limit, all bears are excellent climbers. In our zoological gardens most of them play the rôle of clowns, inasmuch as their movements present the appearance of a clumsy helplessness, while in reality they are accomplished with much dexterity, caution, and delicacy.

The bears are in general omnivorous, delighting both in animal and vegetable food; but here also we meet with differences. There are some which are entirely carnivorous, for example, the polar bear; while other species are almost purely vegetarian. In this family we can point to a series of transitions between these two opposite kinds of diet, transitions which are also recognizable in the dentition.

The dentition of the Ursida is, in fact, distinguished from that of all the other Carnivora by the marked tendency to the omnivorous type, which is gradually developed (in different species) from behind forwards, and is manifested partly in the structure of the teeth, partly in the loss of premolars originally formed on the carnivorous type.

In all bears we observe in each jaw at least two small tubercled molars, to which in the large bears a third is added in the lower jaw. In some American genera the tubercles of these true molars still appear in the form of low but sharp cones, but in the true bears they are so blunt that an isolated specimen of one of these molars might, on account of its massive form and broad grinding surface studded with only insignificant inequalities, be ascribed to a pig.

The carnassial, which in the upper jaw is a premolar, in the lower a true molar, is scarcely distinguishable in form from the other molars, though it is somewhat longer and flattened at the sides, and has rather sharper tubercles. Only in the American genus Bassaris can it be at once recognized as a carnassial by its two sharp external cusps and its internal heel. No one would have thought of distinguishing a carnassial tooth specially if the dentition of the bears had been adopted as the general carnivorous type.

The premolars present the form ordinarily met with in Carnivora, but here again it is found that the premolars of the small American bears (coatis, raccoons, &c.) have a rather sharp, triangular, median lobe, while in the large bears this part is thick and conical. These premolars, moreover, have a tendency to disappear as age advances, so that in some large bears there is a wide interval separating the canine from the cheek teeth.

The canines and incisors preserve the character of carnivores' teeth. But this character is very pronounced only in the genus Bassaris, in which the canines resemble those of the fox, while in the coatis they assume the form of a strong triangular blade, sharp on both edges, and in the true bears become very clumsy, having only a slightly developed conical crown with an enormous root.

The bears of the Old World are, in general, to be described rather as omnivorous than carnivorous in their diet, while most of the American bears have preserved the carnivorous type more strictly.

Since the number of the premolars and molars varies a little, it will be as well to give a few of the formulas for these teeth.

Large Bears, Ailuropus: $\frac{4 \cdot 2}{4 \cdot 3} = 42$ teeth.

Procyon, Nasua, Bassaris: $\frac{4 \cdot 2}{4 \cdot 2} = 40$ teeth.

Ailurus: $\frac{3 \cdot 2}{4 \cdot 2} = 38$ teeth.

Arctictis, Cercoleptes: $\frac{3 \cdot 2}{3 \cdot 2} = 36$ teeth.

In the milk-dentition of the true bears, the bassaris, and the coatis, there are four premolars with rather blunt tubercles, both in the upper and the lower jaw.

In this family we form two large groups: the **Subursida** or Small Bears, with 36-40 teeth and a long tail; and the True or Large Bears (**Ursida**), with 42 teeth and short tail. The two groups are equally represented in both hemispheres.

THE SMALL BEARS

(SUBURSIDA).

Among the American Small Bears the **Cacamizli** (*Bassaris astuta*), fig. 98, forms such an excellent connecting link with the Viverrida, that many naturalists have included it in that family. This elegant animal, whose rather slender body, pointed muzzle, tolerably large ears, and ringed bushy tail remind us at once of the fox and the raccoon, inhabits the forests of Mexico, Southern California, and Texas. The dentition has essentially the structure of that of a carnivore. The tubercles of the molars are pretty sharp, the carnassials, especially that of the upper jaw, well formed and characteristic, the canines slender and sharp. There are in all 40 teeth. A certain approximation to the Viverrida is seen further in the fact that this genus has round the anus a naked patch in which the ducts from the scent-glands open. The feet have five toes provided with semi-retractile claws. The fur, of a pretty dark gray-brown colour on the back, but lighter on the under side, is marked with some dark stripes on the neck. The very strong and thickly-haired tail is marked with alternate white and dark rings.

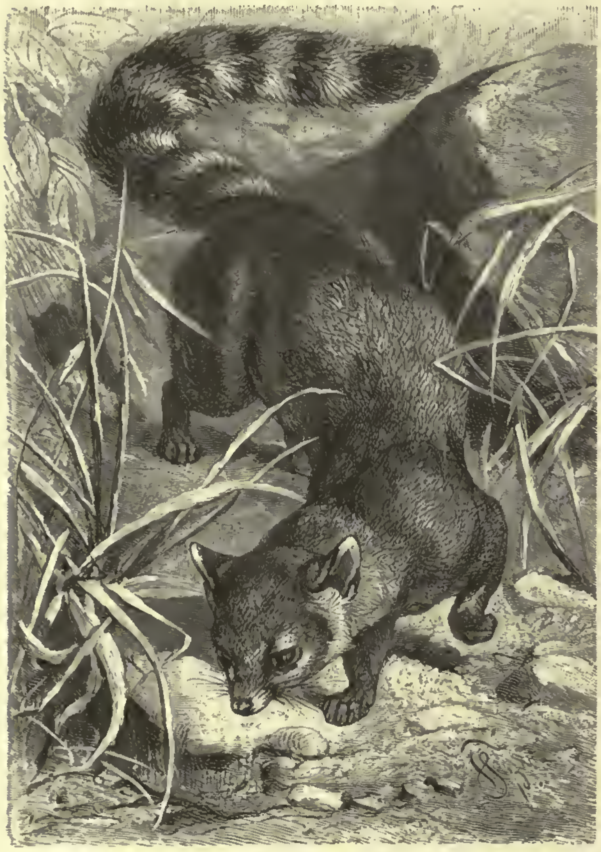


Fig. 98.—The Cacamizli (*Bassaris astuta*).

The animal leads a nocturnal life, and hides by day in holes in trees or clefts in the rocks according as it finds opportunity, lining its retreat with moss and dried leaves. It is often to be found near human habitations, where it hunts after birds, small mammals, and insects. The Mexican name, which means "squirrel-cat," indicates its habits pretty well. It is an agile climber, very shy, but shows a strong attachment to its nest, which it defends courageously even against man. When caught young it is easily tamed, and makes itself useful by hunting after vermin like a cat, and affords entertainment and pleasure by its elegant and rapid squirrel-like movements and by its lively disposition and fondness for all kinds of sports.

The **Raccoons** (Procyon), another American genus, also have 40 teeth, but with a rather different structure. The carnassials in this genus can hardly be distinguished from the tubercled teeth by which they are followed, and if we took only the permanent dentition into consideration, without paying regard to the development, we might say that there were in each jaw three molars with one tubercle and one with several tubercles, while in reality four premolars have been shed. The body of these animals is short and compact, the head broad behind and with a short but pointed muzzle, the legs thin, the tail pretty long and ringed.

Three species of this genus are known, but all very much alike: the **Crab-eating Raccoon** (*Procyon cancrivorus*) of South America, where it is found especially among the mangrove trees on the coasts; the **Mexican** or black-footed **Raccoon** (*P. Hernandezi*) in Mexico and Southern California; and the **Common Raccoon** (*P. lotor*), fig. 99, which owes its specific name, signifying "the washer," to its singular habit of washing its food, or, in the absence of water, at least rubbing it with its fore paws, before it consumes it, an action in which it is represented in the engraving. This species, which ranges throughout North America as far as the limit of forests, furnishes us with a valuable kind of warm fur of a grayish-red colour, which is chiefly used for making mantles, collars, and rugs. The head of the animal shows two broad black patches round the eyes and a stripe of the same colour on the nose. The whole fur is composed of a thick down mingled with long bristly hairs, and the animal seems to be much plumper than it actually is. The raccoon is inclined to be nocturnal in his habits, and is a very intelligent, adroit, lively, and agile creature, which pursues prey just as easily among the trees as on the ground, and whose behaviour, indicating a spritely and frolicsome disposition, has been compared with that of monkeys. He feeds on all that he can lay hold on, and turns for food to the vegetable as well as the animal kingdom. Sweet fruits are just as agreeable to him as small mammals and birds; he shows much dexterity in catching fish and crabs, and is particularly fond of eggs, the contents of which he manages to drain without losing a drop. Insects and their larvæ are manifestly relished by him exceedingly. Of all the Carnivora the raccoon is perhaps the cleverest in the use of his fore paws, for he catches insects in their flight and crushes them between the two front paws, and in general uses these paws almost like hands in carrying the food to his mouth. If there is water near he never fails to betake himself thither to dip his food into it and wash it quite clean before beginning his meal.

Notwithstanding all his agility the raccoon shows much forethought in the measures he takes in pursuing his prey. When he has stilled his hunger he rests in a hole in a tree or in a safe retreat among rocks.

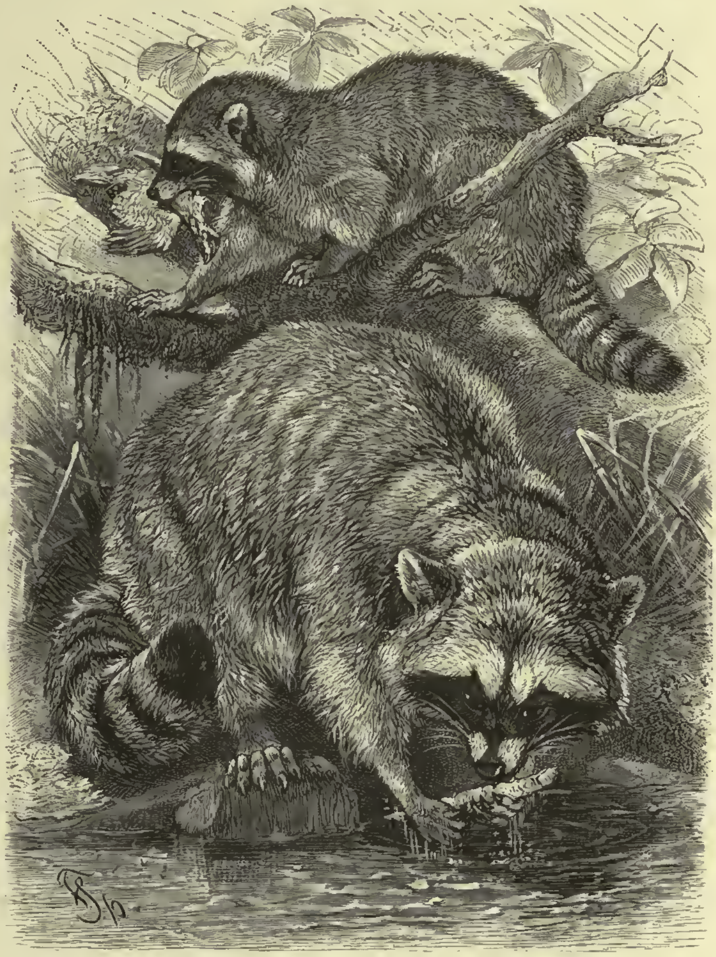


Fig. 99.—The Common Raccoon (*Procyon lotor*).

He is caught in traps, especially in winter for the sake of his fur, and he is also hunted by torchlight with the aid of well-trained dogs for the sake of his flesh, which is much prized. The young animal is easily tamed, and he would be an agreeable domestic pet on account of the attachment he shows to his master, his lively disposition, and his readiness to live on peaceable terms with other animals, if these good qualities were not cast in the shade by his curiosity, which impels him to poke his nose everywhere and to steal everything that is eatable. At first he amuses, but ultimately he becomes a nuisance.

Although very different in their external appearance the **Coatis** or Proboscis-bears,

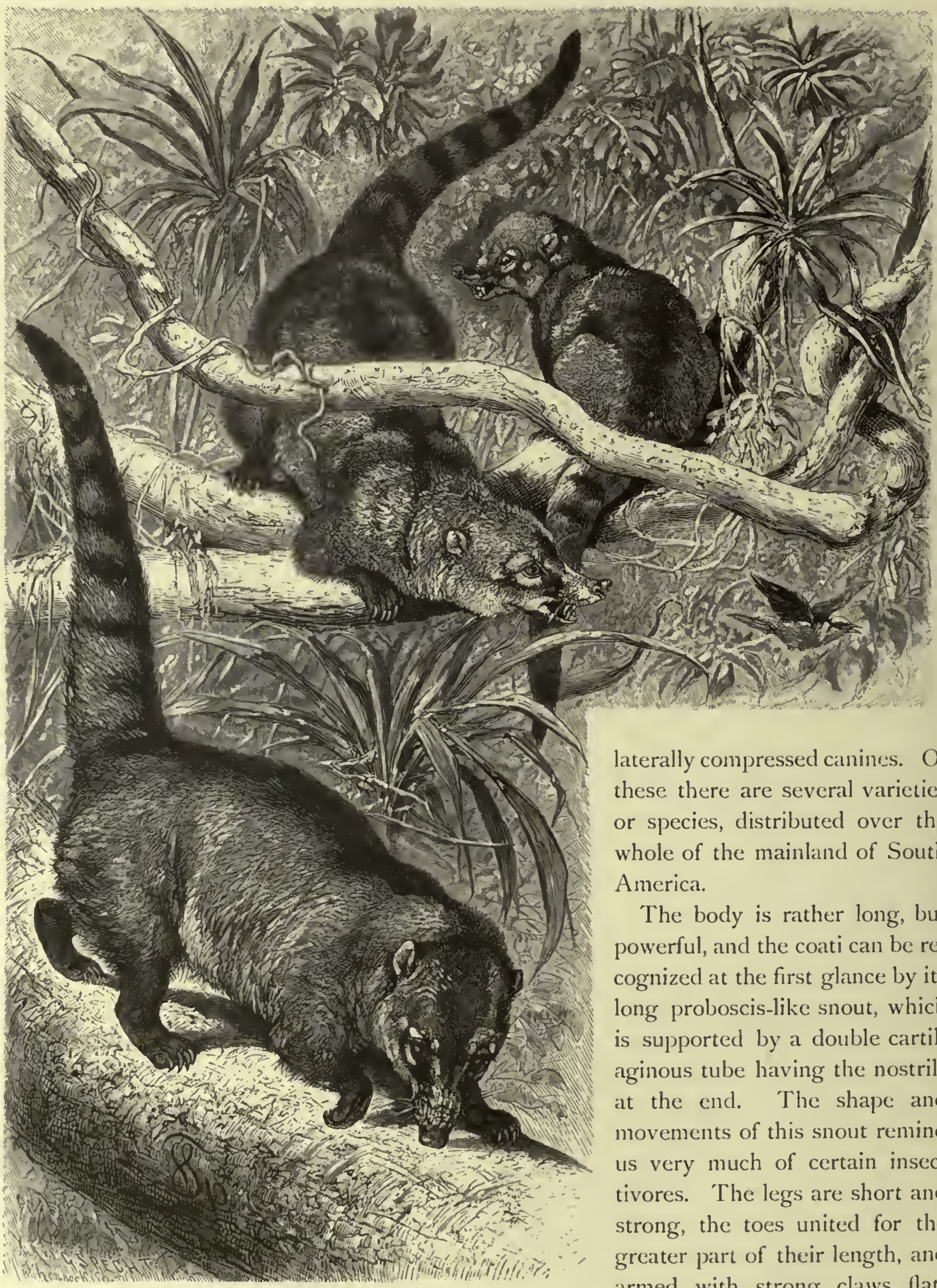


Fig. 100.—The Social Coati (*Nasua socialis*).

forming the genus Nasua, approximate very closely to the raccoons in their dentition, which is distinguished solely by the triangular laterally compressed canines. Of these there are several varieties or species, distributed over the whole of the mainland of South America.

The body is rather long, but powerful, and the coati can be recognized at the first glance by its long proboscis-like snout, which is supported by a double cartilaginous tube having the nostrils at the end. The shape and movements of this snout remind us very much of certain insectivores. The legs are short and strong, the toes united for the greater part of their length, and armed with strong claws flattened on the sides. The tail, which is almost as long as the body, reminds us by its pointed extremity of that of the Egyptian ichneumon.

The species shown in the illustration, the **Social Coati** (*Nasua socialis*), fig. 100, attains the length of a yard and more from the point of the snout to the tip of the tail. The long-haired coarse fur, which is but little valued in commerce, is of a reddish-brown colour inclining to gray, with white spots on the snout and round the eyes; the tail is ringed.

These animals live in pretty numerous companies in the primeval forests of their native land, and hunt their prey with much noise and clatter. The old males separate themselves from these unruly bands in order to live as hermits, and rejoin their companions only at the season of heat. The coatis are the vagabonds of the woods and forests. They climb with great dexterity, go snorting and sniffing all about both on the ground and on trees, and are just as good at grubbing up roots, digging in the ground with their snout like pigs, as they are at snatching birds out of their nests on the branches of the trees. Like the raccoons, they gather into their store everything that they can lay hold of, but prefer eggs, insects, and fruits. They certainly damage the plantations, but yet are not very much disliked, since they but seldom attack the poultry. At the breeding season violent battles take place between the males.

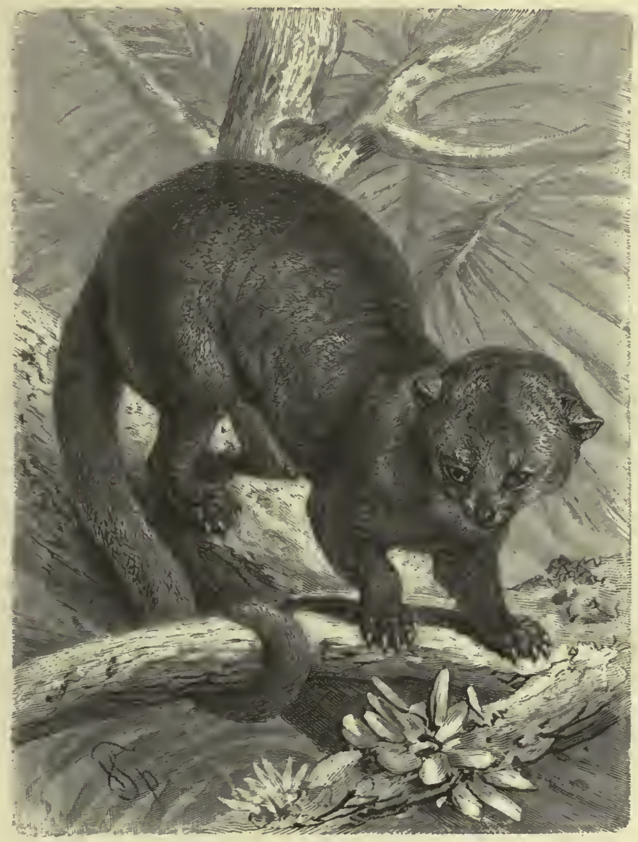


Fig. 101.—The Kinkajou (*Cercoleptes caudivolvulus*). page 202.

The coatis are fiery-tempered, pugnacious animals, always quarrelling and fighting with each other; but they fight out their domestic brawls among themselves, and are always ready to support one another loyally against a common enemy, and courageously to defend their young, who follow their parents about very early. They give each other warning of the approach of danger by a peculiar shrill cry. They are hunted with dogs for the sake of their tender and highly palatable flesh. When pursued they at once take to trees if they can, but if pushed into a corner they will defend themselves with spirit.

In confinement they show little attachment to their masters, to whom they render no obedience, acting entirely according to their own good pleasure, and becoming disagreeable and even dangerous when they grow old. They are set down as having but little intelligence, but they are only defiant and independent. In our zoological gardens they are at once the delight and terror of the monkeys, with whom they are commonly associated. The monkey cannot refrain from teasing the coati, catching hold of its tail, which the latter always carries straight up, and giving it a good shake. The coati, who is thereby thrown into a fury, turns round growling and grunting to snap at its tormentor, who, however, escapes with a single spring to the top of the cage. But the coati is a good climber. In spite of the relative slowness of its movements it pursues the monkey without cessation, often for hours together, and does not give up the chase till it has revenged itself with a good bite.

The **Kinkajou** or Honey-bear (*Cercoleptes caudivolvulus*), fig. 101, is perhaps the most extraordinary type among the American Small Bears. To a body resembling that of a lemur is attached a long prehensile tail like that of a sajou. The head is small and round, the muzzle short, the ears rounded like those of a cat; the tongue is very long and adapted for licking up the honey of the wild bees, of which the kinkajou is extremely fond; the legs are short but strong, the feet five-toed, and the toes provided with sharp curved semi-retractile claws. There are only 36 teeth, since each jaw has only three premolars and two molars with flat crowns. The carnassial is not developed. The prehensile tail is used for the same purposes as that of the sajous; the animal twines on to branches by means of it, hangs itself up by it, and, though it is covered with hair all round, even uses it to seize hold of objects which it cannot otherwise reach. The fur is thick, soft, of a yellowish-brown colour with a golden shimmer, darker on the back than on the under side. The eyes gleam by night like those of a cat.

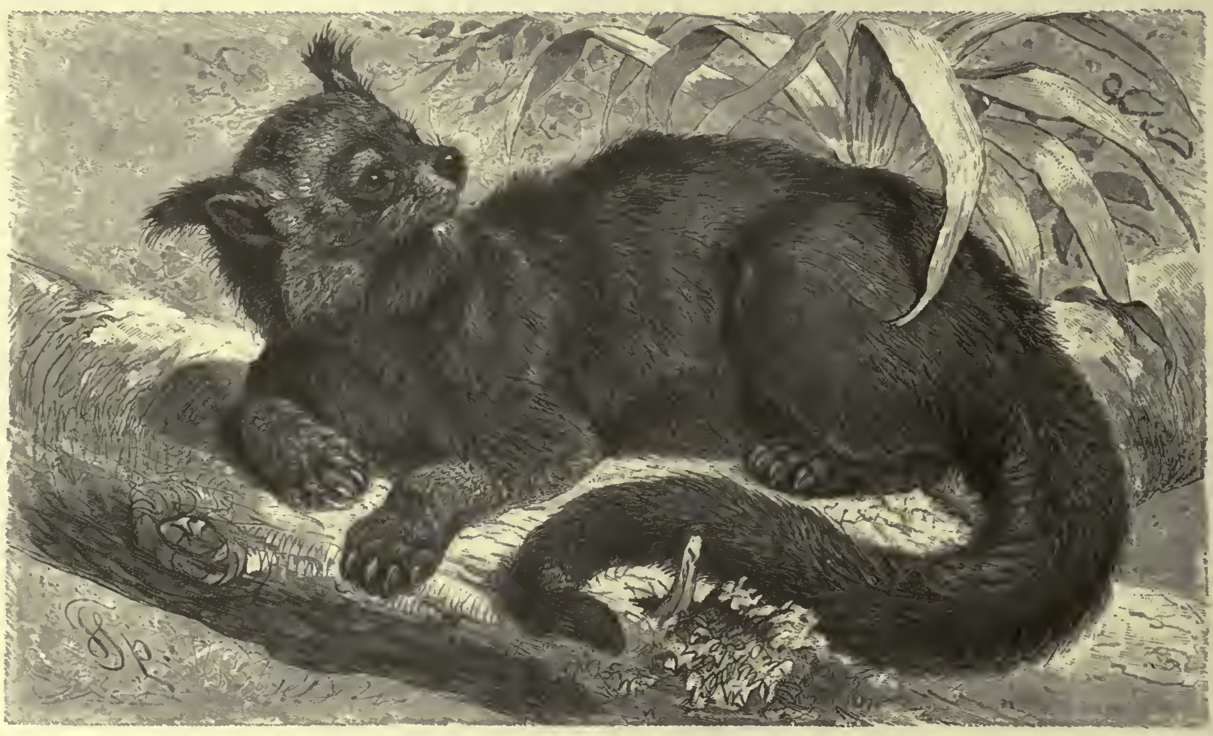


Fig. 102.—The Binturong (*Arctictis binturong*).

The kinkajou lives a solitary life in the primeval forests of South America north of the equator. It is exclusively a nocturnal animal, spends the day in holes in trees, which are carefully lined by it with some material to keep them warm, and seeks its food by night, that food consisting chiefly of honey, insects, and sweet fruits. It is fond of snatching birds out of their nests, and it drinks the contents of their eggs. It uses its fore paws as squirrels do theirs.

The kinkajou, according to all authorities, is a true pattern of virtue in captivity, an animal which carries to its grave a character for faithfulness and honour, which contents itself with what is given to it, is as tender and attached as a child, is fond of receiving caresses and returning them with interest;—in short, it is really a pity that this bundle of amiability, accustomed to a warm moist climate and a nocturnal life, soon perishes under our rude sky.

The Small Bears of tropical Asia are altogether different from those of America.

The **Binturong** (*Arctictis binturong*), fig. 102, inhabits the forests of the Greater Sunda Islands and the neighbouring mainland. The long but powerful body carries a dog-like head, which, however, is adorned with pointed ears ending in long tufts of hair. The legs are short and strong; the feet provided with five free toes armed with strong non-retractile claws. The prehensile tail, covered with long hair, is a little longer than the body, which may attain the length of about two feet from the end of the muzzle to the root of the tail. The fur is rough and coarse, with long bristles on the body and still longer ones on the tail, and of a uniform dead black colour.

The free life of this beautiful climber is little known. It is essentially a nocturnal animal, clambers slowly about on the trees, and renders all its movements secure by means of its tail. The dentition indicates an almost purely vegetable diet. It comprises in all 36 teeth, and the thick short canines are the only marks of the carnivorous nature of the animal. The premolars have blunt conical tubercles; the carnassials are not developed in their characteristic form; the true molars have almost flat crowns.

The animal has been but seldom seen in a state of captivity, but often enough to let us know that it is gentle and quiet in its disposition, and that it by no means despises animal food.

It is much the same with the **Panda** (*Ailurus fulgens*), fig. 103, a wonderfully pretty little animal of about the size of a plump cat, found on the southern slopes of the Himalayas at the height of about 6500 to 10,000 feet. The head resembles that of a cat, or rather of a lynx, except that it wants the tufts of hair present in the latter. The muzzle is very short, the skull round, the face surrounded by large bushy whiskers, the ears moderately large and pointed, the body short and compact, the paws short, five-toed, the toes armed with strong non-retractile claws, the tail pretty long, measuring about 14 inches, while the body measures about half a yard or more. The remarkably long, thick, bushy, silky fur has a beautiful dark russet-red colour, with a golden sheen on the back, while the belly and feet are black. The ears are white within, red on the outside, the whiskers white, the parts round the eyes red.

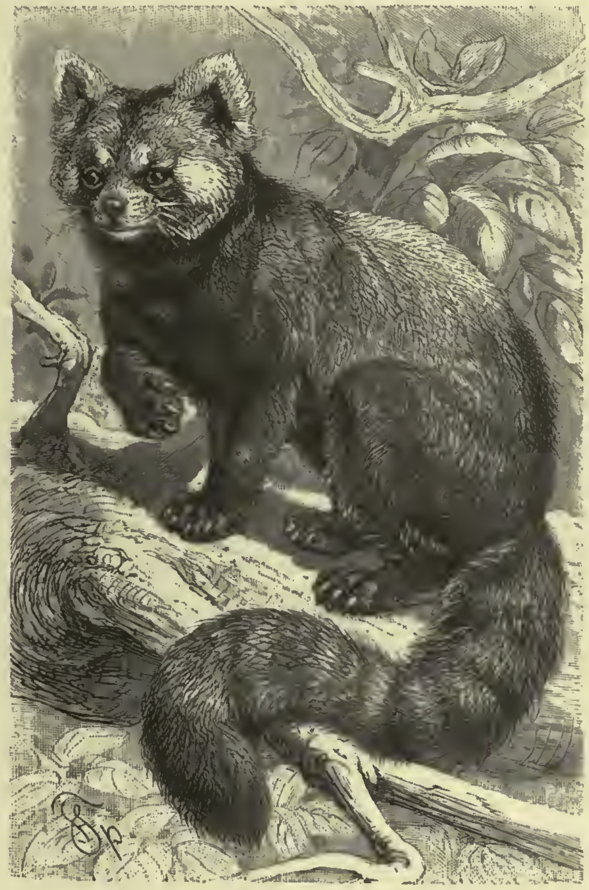


Fig. 103.—The Panda (*Ailurus fulgens*).

The free life of this pretty little nocturnal tree-climber, which is pursued for the sake of its fur, is scarcely known. Judging from its dentition we should conclude that it is essentially a fruit-eater. It has in all 38 teeth; and the tubercles of the molars are so blunt, and the canines so little developed, that its dentition might be compared with that of an omnivorous ungulate. A single living specimen[1] has been brought to Europe, but the poor creature was ill, and recovered with difficulty, and only for a short time. This panda used to place itself in an attitude of defence, getting up on its hind-legs like a bear, and snorting and snarling vigorously, while its usual voice was a sort of twitter. It ate only vegetable food.

---

[1] At least two living specimens have now been brought to Europe, both kept in the gardens of the Zoological Society in London.—Tr.

As a transitional form between the Small Bears, on the one hand, and the True Bears on the other, we mention a very remarkable animal which was discovered a few years ago by Peter David in the high forests of Central Tibet, and which has been called *Ailuropus melanoleucus* (fig. 104). It is of the size of our brown bear, but has a white body, while the feet, ears, and end of the tail are black. Each eye is surrounded by a black ring, and the black colour of the fore-legs is continued over the shoulder to the middle line of the back, so that the animal appears to carry a black yoke. The dentition approaches that of the true bears, comprising in all 40 teeth. Of the four premolars the first is very small and probably deciduous; the others increase in size from before backwards, and gradually approach in the form of their tubercles the two very large molars, which have a wrinkled grinding surface. In general the dentition is similar to that of the true bears, but it nevertheless presents some rather important differences. The very broad feet are placed on the ground in walking for only half their length, as in the panda, to which this large animal has certain points of resemblance in the form of the head and skull. Altogether it is placed by all the known characters of its structure between the panda and the true bears, of which it reminds us by its long coarse fur.

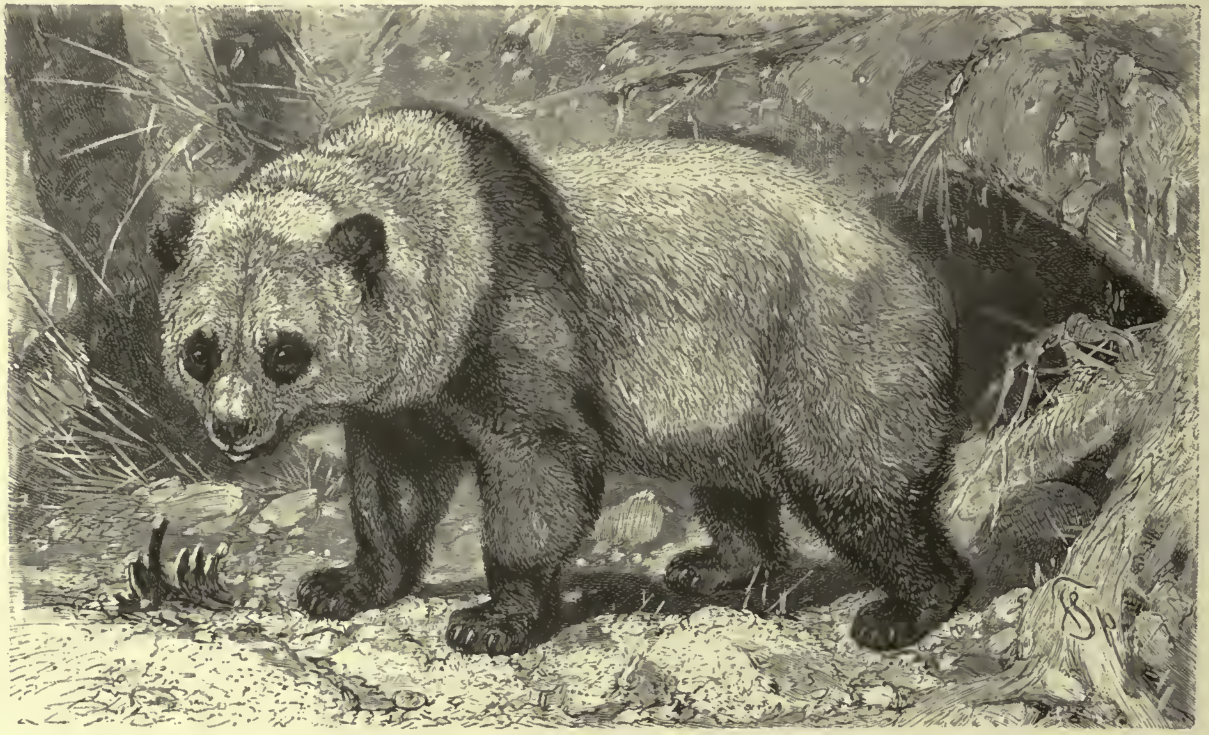


Fig. 104.—*Ailuropus melanoleucus.*

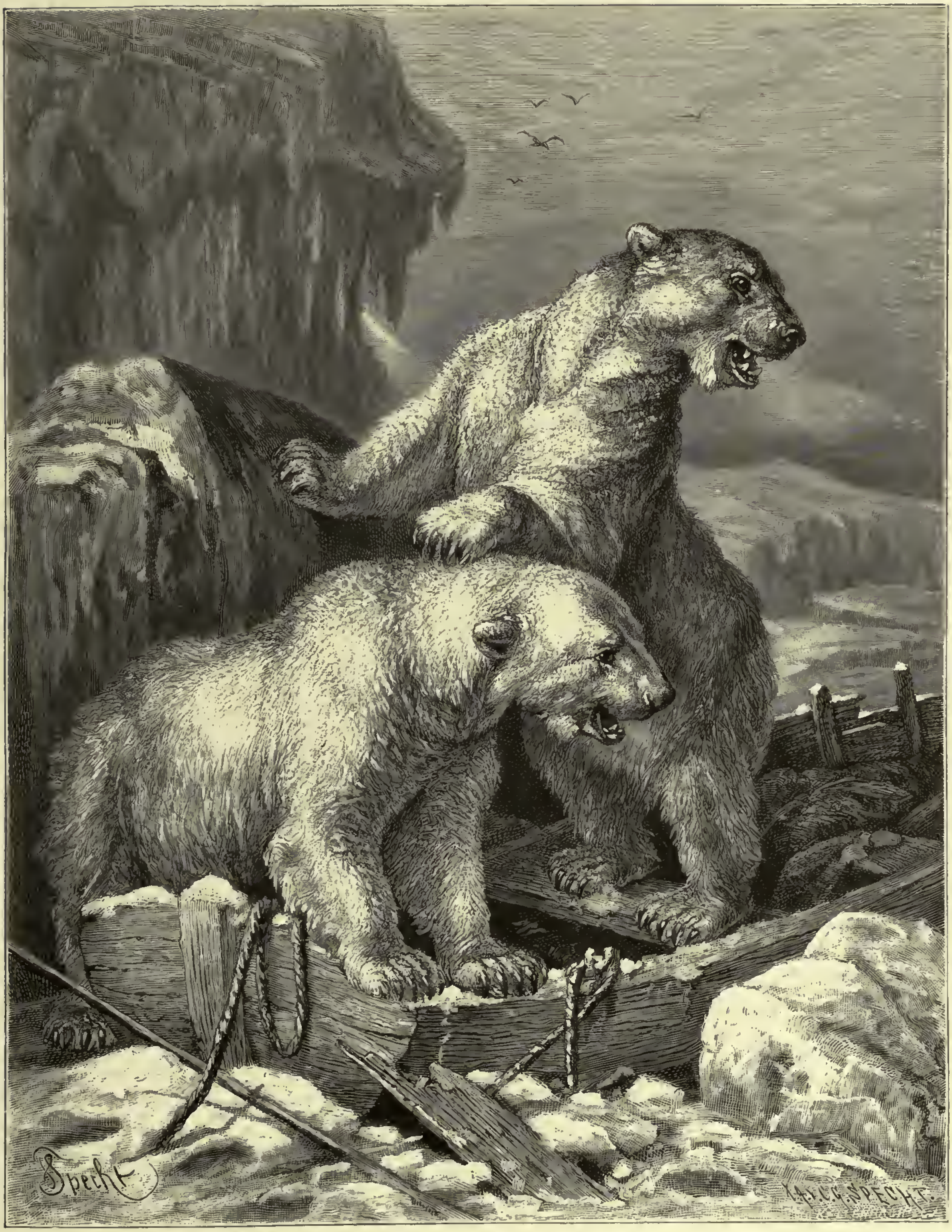
The animal inhabits the almost inaccessible heights of the mountains of Eastern Tibet, feeds chiefly on roots, bamboo canes, and other vegetable substances, never leaves its domain to approach human dwellings; and is known only to a few native hunters who roam over these lofty mountains.

THE LARGE BEARS

(URSIDA).

With 42 teeth, 4 premolars above and below, 2 molars in the upper jaw, 3 in the lower, all with flat wrinkled crowns, on which are low blunt tubercles.

All these teeth are present immediately after the change in the dentition in early life, but they all remain only in some species, while in others some of the premolars or even of the incisors drop out as life advances.


Specht
X.A.V.C.G.SPECHT.

To face page 204.

PLATE XII. — THE POLAR BEAR (*Ursus maritimus*).

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

The tail is always very short, the body and the limbs short and sturdy, the paws enormous and provided with very long claws. The muzzle is usually elongated. The fur of these bears is always in request as a material for rugs and similar articles for which a fine fur is not required. The flesh is palatable, and that of the paws is even considered a dainty.

The only exclusively carnivorous species among these bears is the **Polar Bear** (*Ursus maritimus*), Plate XII., which is at the same time the largest of all carnivores. Old males attain a length of from 8 to 8½ feet, and a weight of 650 to 900 lbs. The polar bear has a rather long but thick and strong body, a long round neck not well marked off from the head, small ears, and a pretty long pointed black muzzle. The eyebrows are pretty well marked, but eyelashes are wanting. The legs are short, very powerful, and fleshy; the paws excessively broad, armed with short curved claws; the sole of the foot almost completely covered with hair, so that only a few small naked callous patches are to be seen. The tail is very short, and scarcely projects beyond the long dense fur, which is composed of fine, almost woolly hair, and is considerably longer on the under side and on the borders of the limbs than on other parts. This beautiful fur, which in the young animal is pure white, assumes a yellowish colour as the bear grows older, and, in contrast to that of other animals inhabiting the far north, it does not change with the seasons.

The cause of this permanence of the white colour is easy to understand. Other polar animals which inhabit the land usually adapt their colour in summer to that of the ground, and become white only when the snow has, as it were, covered their native land with a shroud. The polar bear, on the other hand, inhabits only the realm of ice on the shores of the Arctic Sea, and in summer never ventures far into the land. The ice-girdle which surrounds the north pole is, in fact, its true home. It advances and retires with this girdle which man has in vain attempted to break through, and if it sometimes penetrates into less inhospitable regions it is because it has allowed itself to be carried away by an ice-floe.

Like the tiger and lion in tropical countries, the polar bear is the absolute tyrant of creation in the whole circumference of the north pole. An expert swimmer and diver, and endowed with gigantic strength, he rules both by force and cunning. Seals are his favourite prey, but he manages also to surprise fish in the water, and the reindeer and the Arctic fox on land, and when driven by hunger he does not despise the fresh carcass of a whale, the stores of sailors, or even carrion. He carries on his hunt just as well during the endless night of winter as during the continuous summer of those inhospitable climes. The female alone sleeps during the winter, digging a hole for herself in the snow when she is about to bring forth her young. The scent of the polar bear is very keen, and so also is the sight; these are the two senses by which he is guided in his expeditions.

In his chase after seals, which hide under the ice and pierce holes for themselves by which to breathe at the surface, the polar bear behaves with the utmost caution and cunning. For hours together he remains sentinel at the edge of one of these holes, and if he does not succeed in killing the seal with a single blow of his powerful paw at the instant when the latter puts its head out of the water, then he tries to catch it by diving into the water at some little distance and swimming towards the hole under the ice.

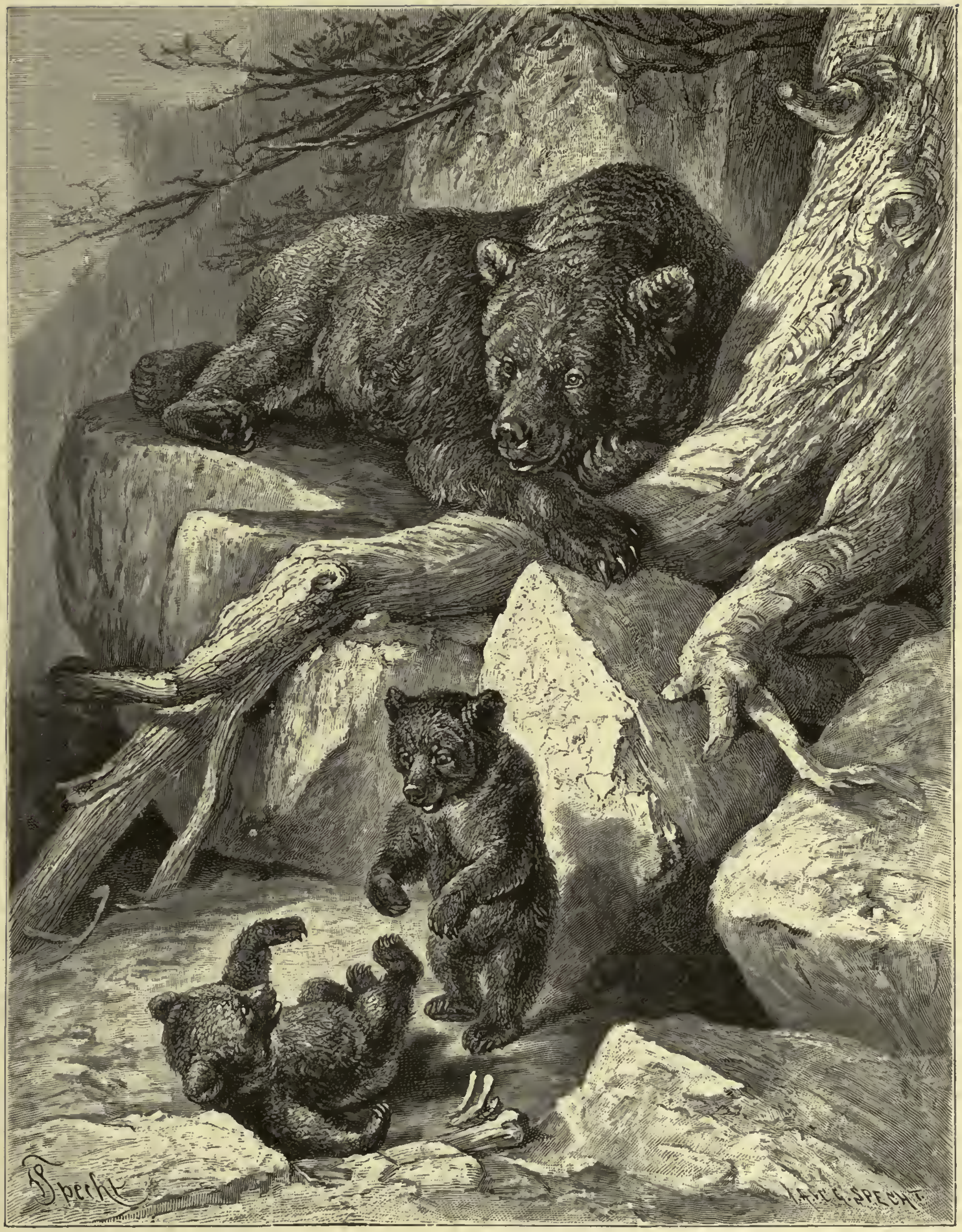
The journals of whalers and Arctic explorers are filled with narratives of encounters with polar bears, which have often had a very disastrous result. We may sum up these narratives by saying that the polar bear when his hunger is appeased very often shuns man, though he does not at all fear him; that when urged by hunger or impelled by a sort of curiosity he approaches ships lying at anchor or dwellings that have been erected on the coast to pass the winter in; that when hungry he attacks man, even though armed, with courage, and that when wounded he becomes terrible. The female defends her young to the last, allowing herself to be killed rather than leave them to themselves. Notwithstanding the apparent heaviness and clumsiness of his movements the bear easily overtakes man in running, and his terrible strength enables him to carry off an unfortunate victim in his jaws without exertion. In spite of the dangers which the chase of the polar bear entails all the inhabitants and visitors of the polar regions give themselves up to it with zeal. Traps, snares, and other artificial contrivances can hardly be used against him. The polar bear removes or escapes them with singular adroitness. The rifle or the naked weapon, spear or hunting-knife, is necessary; and, above all, courage and coolness are requisite. It is a battle for life and death, in which one antagonist must slay the other. But the prize is a powerful inducement. The fur is valuable, the flesh good to eat, and even necessary as a preservative against scurvy. The liver alone seems to be actually poisonous, or at least noxious.

When caught very young the polar bear may be tamed to a certain extent. But even its caresses are not very delicate, and with age it becomes disagreeable, sullen, and dangerous to its keeper.

The **Gray Bear,** the Grizzly of the Americans (*Ursus ferox* (*horribilis*)), represents our European bear throughout the whole of the Rocky Mountain region. It attains a greater size than our bear. Adult males occasionally reach a length of 8 feet, and weigh as much as 900 lbs. The coat has a grayish-brown colour, the hair is pretty long and rough; the muzzle somewhat more pointed, the forehead broader, the teeth stronger and sharper than in our bears. The claws are very long and curved; the tail and the ears pretty short. The skull closely resembles that of a fossil bear with a flat forehead found in the caves along with the true cave-bear. A wood-cut representing the grizzly would, however, be so like that of our own bear that we dispense with it.

By all accounts the grizzly is much fiercer than his nearest ally, our European bear, which he greatly resembles, however, in his mode of life. In most cases he attacks man without flinching, and few instances are known in which he shunned the conflict. The bison is not too strong for him. His fury is all the more terrible the greater his strength. In early life he climbs oak trees to feed on the acorns, while at a more advanced age he scarcely ventures on trees, which have hence often served as places of refuge for men pursued by him. He runs pretty quickly, and swims with ease across the largest rivers. His fur is used for the same purposes as that of our bears; his flesh is highly esteemed. In confinement he behaves like our bear.

Narrow escape from a "Grizzly":—"In 1870 a small party of citizens were going up the Chaquaque Cañon. The trail led along a bench high above the bottom, in which were trees and thickets. The piping of young turkeys was heard in the thicket, and one of the citizens who carried a shot-gun proposed to go down and kill some for supper. The party waited for him. He had hardly disappeared in the thicket before he reappeared in full flight, while close at his heels followed a huge she-grizzly with two cubs. In a few seconds she overtook him and struck him a powerful blow with her fore paw, knocking him senseless. She then deliberately smelt over the prostrate body, and, apparently satisfied that he was dead, went slowly back to the thicket. The party above had been unable to do anything. As soon as the bear left they hastily consulted together, and some of the boldest were about to go down when the body sprang to its feet, and made the best possible time to the top of the hill. An examination disclosed the fact that the bear's claws had struck the man's body behind, just below the waistband of his trousers; and though every particle of clothing, upper and under, had


Specht
X.A.v.G.SPECHT

To face page 206.

PLATE XIII. — THE COMMON OR BROWN BEAR (*Ursus arctos*).

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

been torn from that part of the person, the skin was not broken nor the man injured beyond some slight bruises. He explained that the blow, throwing him forward on his stomach, had knocked the breath and consciousness out of him. When he recovered his senses the bear was smelling at him, and, knowing the consequences of moving, he lay still. I have never heard a more striking instance of presence of mind and nerve."—Dodge: *Plains of the Great West.*

The **Brown Bear** (*Ursus arctos*), although at the present day greatly restricted in range as compared with what he was formerly, nevertheless still inhabits a considerable area, and one may say that he is to be met with here and there throughout the whole of the mainland of the Old World north of the Atlas and the Himalayas. In civilized countries he has been driven to the mountains.

He is a large plump animal, which may attain the length of 7 feet and a weight of 550 lbs. It will be understood that a species distributed over so wide a geographical range as this is must present a number of local varieties more or less different from one another. Hunters and species-makers have accordingly not spared themselves the trouble of distinguishing a considerable number of species, regarding which all that can be said in a general way is that the size of the animals is the less the further south their home lies. The bears of the Pyrenees, the Atlas, and Syria cannot rival in size those of Norway, Russia, and Kamchatka.

I will not give here a minute description of our common bear, which is known to everyone, and which has been depicted by Specht (Plate XIII.) in a manner that cannot be surpassed. The family shown in the plate referred to has established itself in a wild region amongst rocks at the foot of a large fir-tree. The mother observes with watchful eye the sports of her young ones. The plump little cubs are wrestling with each other; the one is rolling on the ground while the other is waddling up to him on his hind-legs, just as old bears do when they are making ready for an attack.

The brown she-bear brings forth two or three young ones during the severest winter's cold, usually towards the end of January. The little bears are very amiable creatures, and in the highest degree comical. Clowns in every respect, clumsy and yet supple, always ready for fun and frolic, good-humoured with every one, docile to a certain point, they yet always exhibit a certain egoistic independence, which later in life becomes changed into sulkiness. The attachment of the mother towards them is without bounds. For several weeks she never leaves them for an instant, remaining without any food in the dark retreat which she had chosen out as the place of her delivery. She teaches them to walk, to climb, and to swim, and defends them with fury even at the risk of her life. But though she overwhelms them with caresses, keeps them warm, licks them, and submits to all their teasing, yet she does not fail to punish them when she thinks that necessary. A good blow with the foot, a box on the ear, and even a slight bite are among the ordinary means of education which she does not spare. It is even asserted that bears two or three years old are employed to educate their younger brothers and sisters. Such teachers are called by the Russians "Pästun."

I cannot agree with some recent authors in denying to the bear wiliness, attachment, affectionateness, and intelligence. The young bear is, on the contrary, wily, intelligent, shrewd, and devoted to his comrades. But why should he be attached to man, who keeps him in confinement and treats him to blows as soon as he shows a disposition to live after his own fashion? Shrewdness and a power of observation belong to the bear in good measure. In the course of a voyage which we ourselves made to the North we happened to have on board a bear six months old which had shortly before been caught in Russia. He yielded only to violence, and would not obey me till he had got a good cudgelling, which banished him to his den for some days. But he was perhaps the most intelligent animal that we had on board, including both dogs and foxes. On the deck there stood a cask filled with salt meat. The other animals sniffed all round it, and endeavoured unsuccessfully to gnaw through the wood. The bear, after attentively examining the cask for a whole day, at last found the bung, and this he managed to pull out with his teeth and paws so that he could introduce his long snout into the hole and lick the contents. The cook complained of him bitterly, because he was far cleverer at plundering his stores than foxes and dogs. The young bear may be uncouth, clumsy, and obstinate—but awkwardness and clumsiness do not exclude intelligence.

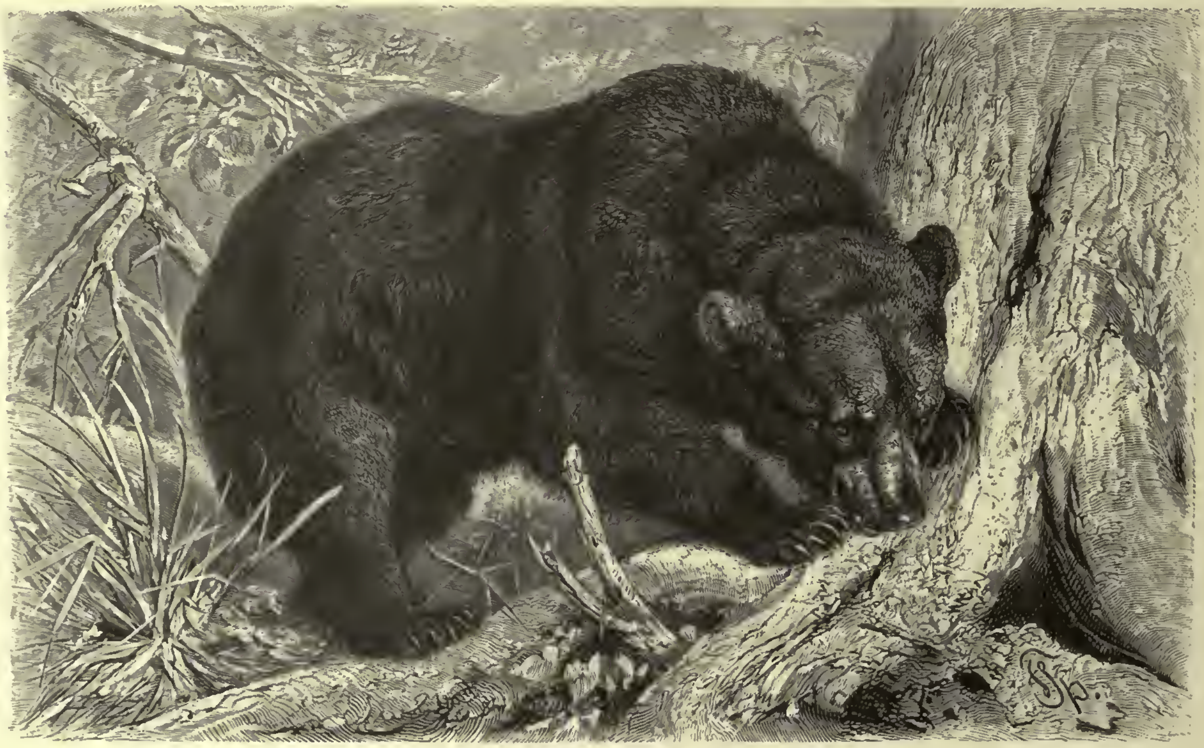


Fig. 105.—The Black Bear (*Ursus americanus*).

The bear, like other carnivores, becomes sullen and even malicious in old age. But even then it is principally when his rest is disturbed that he makes himself disagreeable. He will spend whole hours sucking at his paws and gently growling the while. My bear had the habit of sucking in that way at the end of my dressing-gown or the bottoms of my trousers when I sat studying on deck. If one disturbs the bear in this peaceful occupation he becomes furious; but one who passes quietly by without disturbing him he allows to go on his way unmolested.

And yet not always. In summer, when he is principally a vegetarian, feeding chiefly on berries and other fruits, roots, honey, and ants, even the old bear is a good-humoured fellow; in winter he becomes a flesh-eater, and when hunger torments him he spares nothing. He then attacks man as well as the largest animals, pursues horses and oxen running, breaks into dwellings and stables, slaughters every living thing, and fills the neighbourhood with terror by his growls.

The chase of the brown bear is always dangerous, but is a favourite sport among the inhabitants of the North. The bear knows the danger that threatens him, and takes to flight. When assailed by the dogs he at last stands at bay. With one stroke of his powerful paw he slits open the belly of a dog or breaks its back-bone. If only wounded by a hunter he dashes upon his antagonist, and then getting up on his hind-legs tries to suffocate him in his embrace. Only in case of the direst necessity does he use his teeth. A blow with his paw suffices to lay a man at his feet. The people of Siberia, notwithstanding his enormous strength, attack him in the same way as the Indians do the jaguar. They wrap a sheepskin round their left arm and stab the bear with a dagger or cleave his head with a heavy blade at the instant when he stands up. But it requires a strong fellow to carry on that kind of hunt.

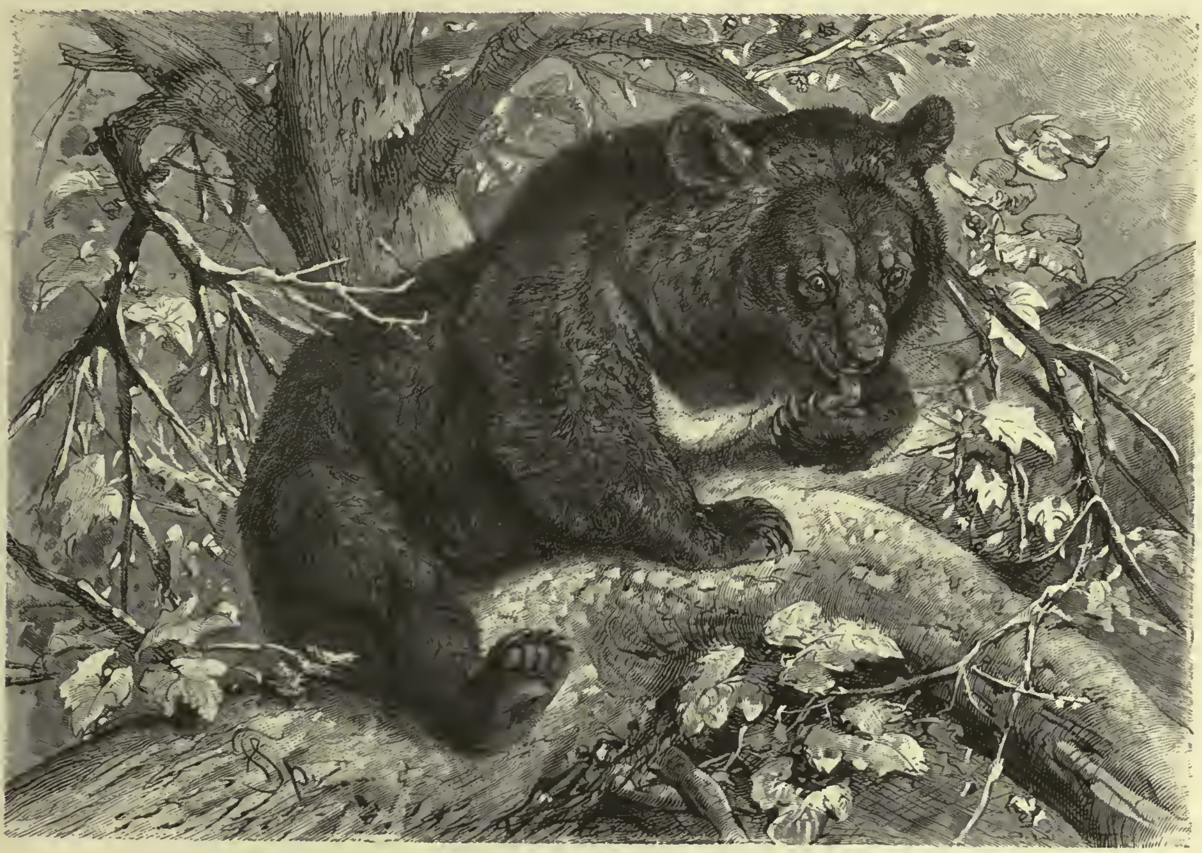


Fig. 106.—The Malayan or Coco-nut Palm Bear (*Ursus malayanus*). page 210.

The **Black Bear,** or Black Baribal (*Ursus americanus*), fig. 105, which attains the length of about 6½ feet at the most, is a harmless creature compared with his brown cousin. A sort of good-humour and fondness for gymnastic exercises on trees appear to be the essential traits in his character. The glossy black bristly hairs of his loose fur are so long that they cover even his toes and tail and give him a terrible appearance, which is not borne out by his behaviour. All young bears have on their breast a more or less light-coloured patch shaped like a half-moon; in the young of the black bear the patch is white or yellow and resembles a neck-shield. In the southern bears this patch persists through life, while in our species it mostly disappears with age.

The black bear prefers the woods, and climbs from pleasure and not merely from necessity. It often hides in hollow trees. Almost a strict vegetarian, it nevertheless attacks animals when hungry, and is not embarrassed in the presence of herds and flocks, but always flees from man. When attacked it defends itself bravely, and since it possesses great stubbornness and extraordinary strength, it becomes dangerous when wounded. It is hunted for the sake of its fur and flesh. In the opinion of the Indians it is the most intelligent animal in creation after the beaver. It is more easily tamed than our common bear, and it amuses soldiers, nurse-maids, and children to an extraordinary degree by its gymnastic tricks and by the beseeching, humble, and pitiful attitudes it assumes in begging for a bit of bread.

Among the southern bears with a light-coloured neck-fillet and black fur we mention the **Malayan or Coco-nut Palm Bear**, the **Bruan** of the natives (*Ursus malayanus*), fig. 106, of which a sub-genus has been formed by some under the name of Heliarctos.

It is a very small ugly animal, with a thick head, lank body, pretty long legs, enormous paws and very long strong claws, and with only three premolars and two molars in each jaw. It may attain the length of about 4½ feet. Its short smooth fur is of a brilliant black except for the whitish-yellow neck-fillet.

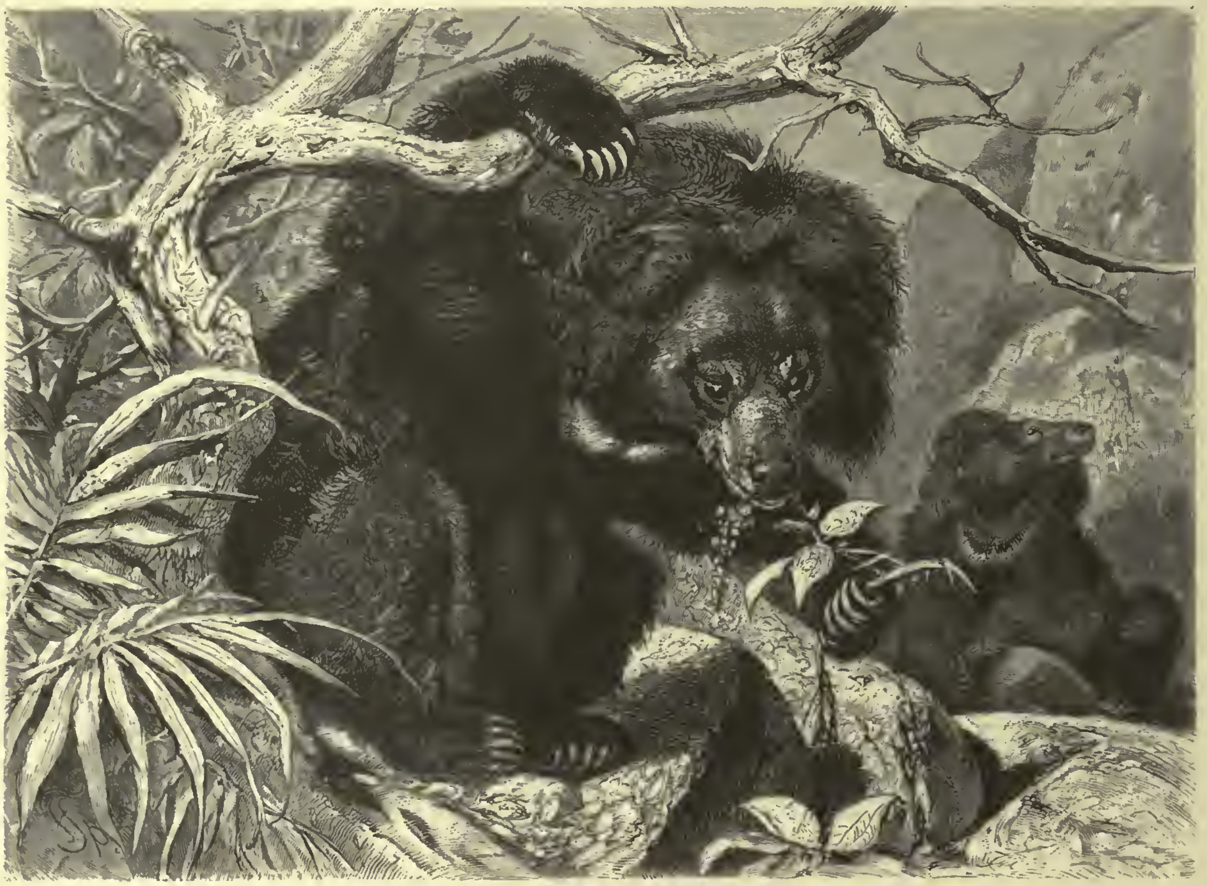


Fig. 107.—The Indian Black Bear or Sloth-bear (*Ursus labiatus*).

This inhabitant of the Sunda Islands, Nepal, and Cochin-China is perhaps the most expert climber among all the large bears. It lives exclusively on vegetable food, and renders itself detested by the natives through the ravages which it commits in the plantations. Coco-nuts, which it opens very cleverly, appear to be its favourite dainty. Wonderful tales are told of the dexterity with which this bear climbs the smooth stems of the coco-nut palms. His tongue is excessively long, and he uses it like a noose to pluck the bananas that he cannot otherwise reach. Of a harmless disposition, he can easily be tamed when caught very young and kept in the warm moist climate of his native land. The specimens which have been kept in confinement in Europe have been obstinate, dirty, and even ill-natured, and have endeavoured to get free, or at least sought to pass the time, by gnawing at the wood of their cage.

The **Common Indian Black Bear** or Sloth-bear (*Ursus labiatus*), fig. 107, which has been taken as the type of a separate sub-genus (Prochilus),[1] is one of the most peculiar forms to be found among the bears. It grows to a considerable size, attaining the length of about six feet, and attracts attention by its long flat-browed head ending in a movable proboscis, on which the nostrils open in the form of slits protected by flaps, which are constantly in motion. The thin lips hang down over the mouth, and can be pushed out in the form of a tube. The very long thin flattened tongue resembles that of a giraffe, and is used as an organ for grasping. The large paws are armed with enormous sharp sickle-shaped claws, reminding us by their form of the claws of sloths.[1]

---

[1] It is the *Melursus ursinus* of Shaw.—Tr.

The Indian black bear inhabits the mountain forests of India and Ceylon. It climbs the highest trees with ease, seeking fruits and the nests of wild bees, of which it is extremely fond. With its long claws it opens the most solidly built nests of the termites, which it devours just as greedily as our bear does ants.

The sweeter the fruits and plants are the more are they sought after by this animal, which likewise commits great ravages in the sugar plantations. He rests during the hot hours of the day, and prefers the cool nights for his plundering expeditions, in which he but seldom attacks animals.[2]

The reputation of the Indian black bear is different in different places. On the mainland he is regarded as a tolerably peaceable animal, and yet liable to outbursts of rage. When disturbed in his comfortable repose, or when one seeks to ward off his attacks on the beehives, he takes it very ill. In Ceylon the Indian black bear is even more dreaded than the tiger. Everywhere he is regarded as very cruel. The natives maintain that in making an attack he always aims at the eyes, endeavouring to tear them out with his claws, and afterwards strangling his victim and rending it in pieces.

The apparent good-nature of the Indian black bear in confinement is not to be trusted. Many a keeper has been very severely handled in consequence of sudden accesses of fury in this savage animal. In their native country these animals are trained to dance, and led about by a ring through their nose to furnish amusement, as the brown bears are among us.

THE BADGER AND WEASEL FAMILY

(MUSTELIDA).

Except a single species all the Carnivora belonging to this family have a single large tubercled tooth in each half of the upper, and two molars in each half of the lower jaw.

The finest and most valuable furs are derived from this family. The costliest of all furs are in fact those obtained from the martens and otters. The sea-otter, the sable, and the visons are everywhere regarded as the jewels of the fur trade. To wear ermine was at one time the prerogative of princes, and even the inferior sorts, such as the furs of the American marten, the common marten, and the polecat still hold the first rank in the trade.

The members of this family are in general small animals, for the great majority are on an average only about 18 or 20 inches in length.

Only the dentition, of which we will speak below, can furnish fixed characters for the marking off of this numerous family, which includes the greatest diversity of forms. There are long and slender forms, like the marten or weasel, which for this reason have been called the "worm-shaped" Mustelida, and in contrast to these, the plump compact forms which approach the bears in their external aspect. While some are plantigrade like the former family, others are digitigrade or semi-plantigrade. Some have sharp more or less retractile claws, while in others the claws, though strong, are immovable. In short we see in respect to the form of the body and the structure of the feet almost as many diversities as there are between the cat tribe on the one hand and the bears on the other.

---

[1] It is partly to this circumstance, partly to the fact that the inner incisors frequently drop out very early in life, that this animal owes the vernacular name of Sloth-bear, by which it is often known. —Tr.

[2] Mr. G. P. Sanderson in his *Wild Beasts of India* mentions instances in which the Indian black bear has been known to eat the flesh of dead animals, but he adds that it never attempts to kill animals for food.—Tr.

Equally varied is their mode of life. Some are excellent swimmers, hunt only in the water, and have all the qualities belonging to diving animals; others range about over the surface of the earth, and even make their retreats in underground holes dug by themselves; others again lead an active aerial sort of life, climbing on trees, and surpassing even the agile squirrels in dexterity and rapidity of movement. If the weasels, polecats, and beech-martens are true blood-suckers which murder without mercy and so to speak revel in massacre, others are rather peaceable and timid animals, which feed chiefly on plants, and appear to have their sharp teeth only for defence. We thus observe in this family a number of varied adaptations—more diverse, indeed, than in any other group of the Carnivora.

One single character belongs to them all, but it is developed in them in various degrees, and it is one that they share with the Viverrida and Hyænida. It consists in the anal scent-glands, or rather stink-glands. Though the musk of the civet is used in perfumery, it would never occur to any one to use the secretion of the polecat in that way, and still less that of the skunks. So much the worse for the beautiful furs. Even those derived from the animals which are the least obnoxious in respect of their smell, require the most assiduous labour to deprive them of their offensive odour, while in the case of the skunk all efforts are thrown away.

The dentition of the Mustelida exhibits a tolerable amount of diversity, but in all cases we can recognize a well-defined general plan. Both above and below there are six small close-set incisors in the front of the mouth; only in the sea-otter, which has no more than four in the lower jaw, is this number reduced. Very rarely is there any marked difference to be observed between the outer and inner pairs of these teeth, as is the case in the cat tribe; yet there are species which eat a great deal of flesh, as, for instance, the ermine and tayra, in which the outer pair in the upper jaw become quite conical or even recurved.—The canines are usually slender, thin, very sharply pointed, but never have longitudinal furrows or sharp edges as in the cat tribe. The true molars are pretty constant in number and form. There is always in the upper jaw a single pretty thick transversely placed tubercled tooth immediately behind the carnassial, the tubercles usually four in number, and sometimes rather pointed or even sharp, sometimes blunted and flattened. The two extremes in the series are formed, on the one hand by the genus Lyncodon, a weasel-like creature belonging to Patagonia, in which this tooth is narrow and almost sharp; and on the other hand by the sea-otter, in which it is the largest of all, and has the tubercles so blunted that it might be taken as the tooth of a herbivorous animal.

With a single exception the lower jaw has two true molars, the first of which is the carnassial. Originally this latter tooth has three sharp cusps, but the posterior cusp usually gets worn away by the pressure of the opposite carnassial in the upper jaw, so that it often assumes the form of a hollow heel. The tubercled tooth following the carnassial is usually small and roundish with a rough grinding surface. In Lyncodon this tubercled tooth is wanting.

The premolars present the greatest amount of variety. The last of these, the carnassial of the upper jaw, usually furnished with two strong external cusps and an internal heel, gets blunted like the lower carnassial, and in the sea-otter in particular it does so to such a degree that it may wholly lose its character.

In a large number of genera, the badgers, gluttons, and true martens, there are three other premolars in front of the upper carnassial, bringing the total number of these teeth up to four. These three premolars increase in size from before backwards, and either have a laterally-compressed sharp-pointed cusp or are in the form of a more or less truncated cone. In some genera, as, for example, in the otters, the first premolar is so small and insignificant that it is placed, not behind, but on the inner side of the canine. In the lower jaw there are originally four premolars in front of the permanent carnassial, and these have similar forms to those in the upper jaw, and exhibit the same increase in size from before backwards.

But this original number of four premolars above and below is preserved only in the true martens and the gluttons, and in both jaws there is observed in different members of the group a gradual diminution in the number of these teeth from before backwards, a diminution whose last stage is seen in the Lyncodon, in which the number is reduced to two in each half of the jaw. The two extremes in this series are thus as shown in the following formulas:—

Complete Dentition.	Reduced Dentition.
Mustela, $\frac{3\cdot1\cdot4\cdot1}{3\cdot1\cdot4\cdot2}=38$.	Lyncodon, $\frac{3\cdot1\cdot2\cdot1}{3\cdot1\cdot2\cdot1}=28$.

All the steps intermediate between these extremes occur.

Leaving out of account the incisors and canines, the number of which is always the same, namely 16 (except in the single instance above mentioned), we find in fact the following variations in the premolars and molars proper:—

$\frac{4\cdot1}{4\cdot2}$ = 38 teeth: Mustela, Gulo.

$\frac{4\cdot1}{3\cdot2}$ = 36 teeth: Meles, Taxidea, Helictis, Lutra, Arctonyx.

$\frac{3\cdot1}{3\cdot2}$ = 34 teeth: Mydaus, Mephitis (in part), Galictis, Putorius, Rhabdogale.

$\frac{2\cdot1}{3\cdot2}$ = 32 teeth: Mephitis (in part).

$\frac{3\cdot1}{2\cdot2}$ = 32 teeth: Mellivora.

$\frac{2\cdot1}{2\cdot1}$ = 28 teeth: Lyncodon.

Beyond doubt this progressive reduction distinguishes a family, the characters of which are not yet completely determined, and which along with archaic types possesses a number of other forms.

The Mustelida may be divided according to the structure of their feet into three groups: Plantigrada: the Badgers (Melida); Digitigrada: the Martens (Martida); Web-footed forms: the Otters (Lutrida).

GROUP OF THE BADGERS

(MELIDA).

Plantigrade carnivores, with thick-set clumsy body, short feet, and highly developed anal glands.

Our **Common Badger** (*Meles taxus*), fig. 108, may be taken as type of the group.

The rather long head gradually narrows in front to a naked snout, like that of a pig, with which the badger has often been compared also on account of the thick rounded body somewhat higher behind than in front. The eyes and ears are small; the legs very short and thick, the paws naked on the sole and with five toes carrying long curved claws, which on the fore-paws are very prominent and, as in all burrowing animals, sharp and broad. The tail is short and thickly covered with hair. At its root near the anus is a pretty broad transverse fissure forming the opening of the pouch of the stink-gland, which is almost quite destitute of hair.

Like most species of its genus the badger has a rough coarse fur mixed with pretty long bristly hairs, and presenting the exceptional character of being darker on the under side than on the back. The belly and paws are black while the back is grayish yellow. Two longitudinal black stripes extend from the snout backwards across the eyes and ears. The hide was formerly much used in making trunk-covers, wallets, and portmanteaus.

The dentition exhibits a carnivorous character only in the incisors, canines, and premolars, while the true molars, especially those of the upper jaw, are very broad, and bear witness to an adaptation for a vegetable diet. The animal attains a length of 2½ feet and a weight of about 55 lbs.

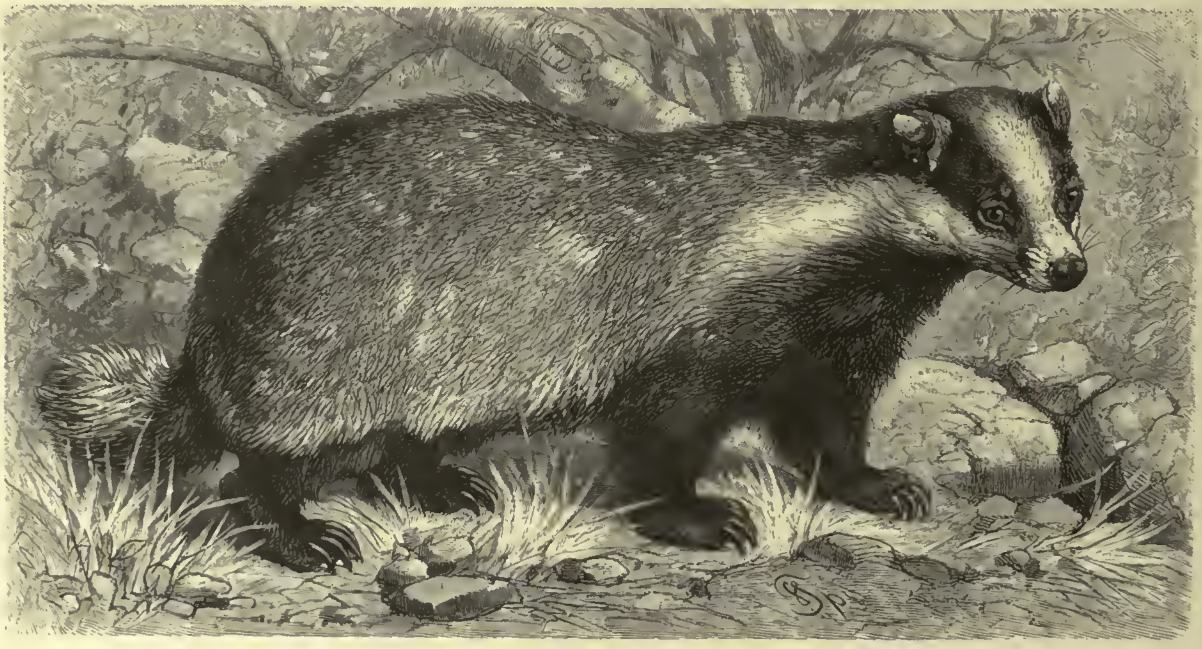


Fig. 108.—The Common Badger (*Meles taxus*). page 213.

In fable the badger plays the rôle of a peace-loving, gentle, and cautious Philistine, who loves beyond everything his comfort, his family, and his house, but who may become furious if alarmed or disturbed in his habits. He is the cousin and friend of the fox, whom he vainly seeks to lead back to the path of virtue, but whose defence he undertakes as a good-natured relative in spite of all the malicious tricks that Reynard plays him. With the exception of this friendship, which can scarcely be said to exist, the leading traits in the character of the badger are summed up with great ingenuity in these fables.

The badger is distributed throughout the temperate zone of the Eurasian continent, and extends even to Japan. Everywhere its habits are the same. With great circumspection it chooses out the place in which to dig its hole, preferring the slopes on the sunny side of lonely wooded hills. Passages of 8 to 10 yards in length, and sometimes as many as ten in number, lead to a large underground chamber, which is made warm with moss and dried leaves, and is inhabited either by a solitary male or by a female and her young. Only two or three of these passages serve as the ordinary means of egress, the others are intended for ventilation, or for flight in case of urgent danger. The utmost cleanliness is maintained in this dwelling, which is excavated at the depth of some yards below the surface of the ground.

In this comfortable and safe habitation the badger spends the day, and he leaves it only with great caution on the advent of night. In very silent and lonely places he may be seen going out by day to warm himself in the sun. Often the fox annoys him, but in most cases he cedes to him part of his dwelling, retiring himself to the deepest part of his chamber.

In southern lands, on the shores of the Mediterranean, for example, the badger remains active the whole year round, but further north he passes the winter asleep. This sleep, however, is never very profound, and fine mild days very easily awake the sleeper. During this sleep the badger becomes very lean. On the first sunny day of spring he goes out hungry in search of food. He takes what nature can offer him. In Siberia he is so entirely carnivorous that he attacks even the herds of cattle in order to slay calves. In Germany he hunts in spring for mice, rats, moles, nests of ants and humble-bees, going about grunting like a pig, and turning up the earth with his snout. He thereby makes himself useful in destroying a number of subterranean insect larvæ, caterpillars, worms, and snails. Eggs and small birds which make their nests on the ground are devoured by him just as readily as lizards, serpents, toads, and underground fungi. Truffles and other fungi, as well as a few juicy roots, are eaten as accompaniments to the staple of his meal. To the stings of ants and humble-bees he pays little heed, shaking these assailants off with a grunt. On the approach of autumn the badger becomes more herbivorous, and grows fatter and fatter every day. Fruits of all kinds, starchy tubers, sweet bunches of grapes and currants, and the like, are then more sought after than mice; but if these or young hares or partridges fall in his way, then he eats up with pleasure the dainty with which fortune has provided him.

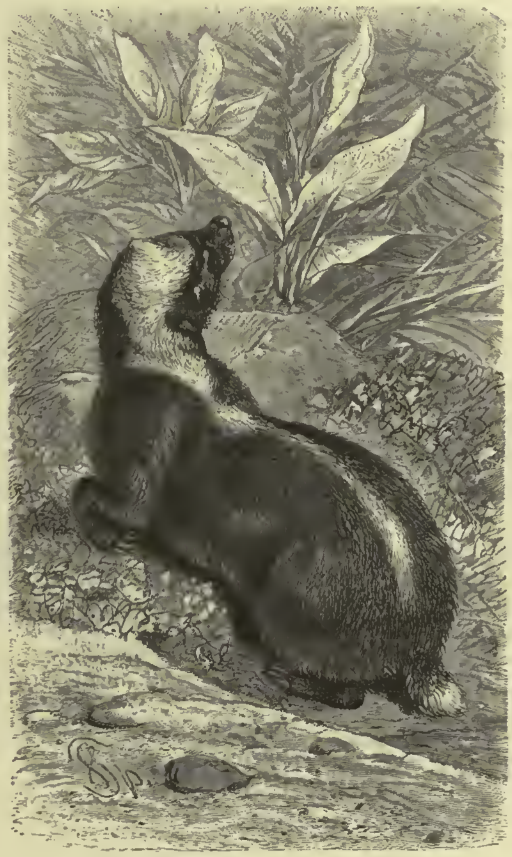


Fig. 109.—The Telagon (*Mydaus Telagon*). page 216

The breeding season occurs in October, when his table is most abundantly supplied. The hermit then changes his habits for a few weeks, and follows the precepts of civic law in offering a suitable home to his spouse. But this common housekeeping does not last long. The couples separate from bed and board in order to hold the usual winter-sleep. In the beginning of March the female gives birth to from three to five blind young ones, which she tenderly nurses by means of three pairs of teats, one on the breast, and two others on the abdomen. In order to maintain the cleanliness so dear to the badger the female digs out a retired chamber beside that in which they live, and accustoms her young ones to make use of this for the satisfaction of their needs. The invention of the earth-closet free from smell has accordingly been made by the badger. The female supports her young for a long time after the weaning, bringing in worms, snails, honey, fruits, and roots for them. Towards autumn the young badgers leave the maternal habitation in order to set themselves up as hermits on their own account.

The badger, as already mentioned, is cautious. It quits its hole only after it has sniffed and carefully examined the neighbourhood all round, and on the slightest danger it takes refuge in one of its passages. When driven into a corner, however, it defends itself with courage, laying itself on its back and fighting with claws and teeth. When pursued into its hole by dogs, it leans its back against the back of its chamber while resisting the aggressor with its claws and teeth, and only when attacked by several dogs does it resolve to quit its retreat. It is caught in nets spread in front of the passages leading out of its hole; sometimes it is shot at the instant of emerging from the ground; sometimes it is dug out or pulled out of its hole after being transfixed with a long spike. The flesh is not bad to eat, and the fat is used in preparing various salves to which great remedial virtues are ascribed. Young badgers have been tamed, but these experiments have found few imitators.

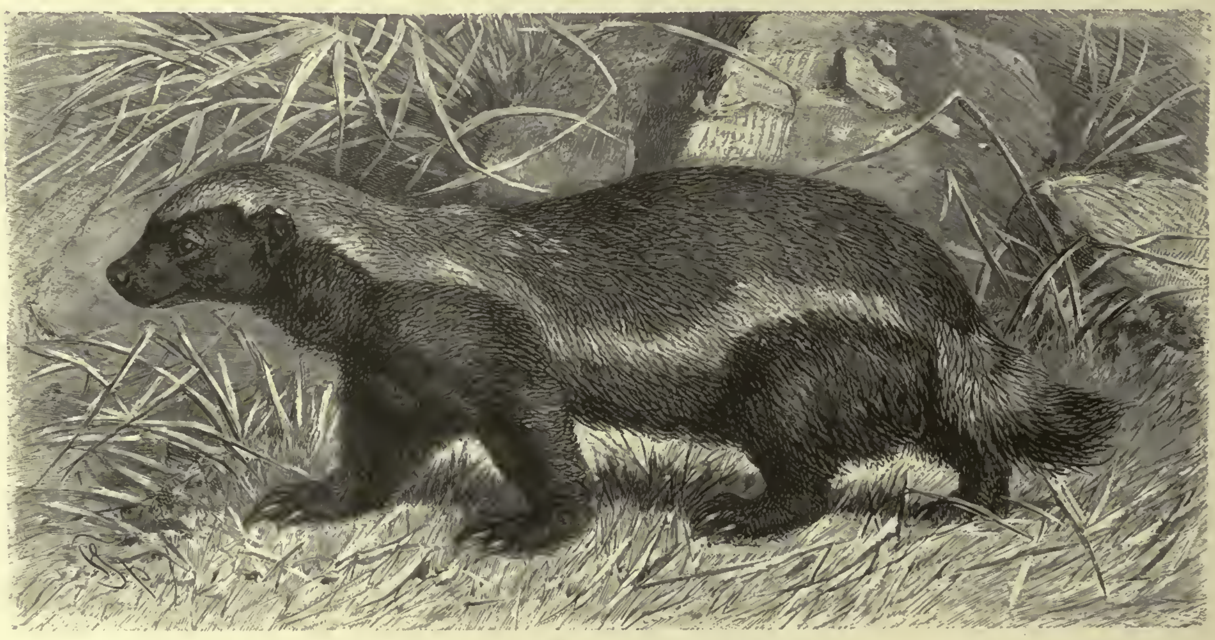


Fig. 110.—The Cape Ratel (*Ratelus capensis*).

The **American Badgers**, on account of certain peculiarities in their dentition, have been ranked in a separate genus under the name of Taxidea. They lead a similar life to our badger, and are found throughout North America from the 38th parallel of latitude to Mexico. The **Indian Badgers**, which have a longer and less bushy tail, are likewise referred to a separate genus under the name of Arctonyx.

The **Telagon** or Stinking Badger (*Mydaus Telagon*), fig. 109, which inhabits the islands of Java and Sumatra and the neighbouring parts of the mainland, is still more of a burrower than the common badger, from which it is distinguished by its more pointed snout, longer body, rudimentary tail, ears hidden under the hair, and its longer fore-paws and toes, which are united together as far as the roots of the long and sharp claws. The fur, composed of long thick hair, exhibits a uniform brown colour except for a white stripe which runs from the head along the back nearly to the root of the tail.

This little animal, which attains a length of 14 inches at most, is found only on mountains above 6000 feet in height, and has similar habits to our badger. The stink-glands at the anus serve as a means of defence. By muscular pressure the telagon can squirt the ill-smelling moist secretion of these glands to a distance of several feet. The stench is so strong that it may be smelt under the wind at the distance of half a mile or more. The flesh is said to be palatable, but only if the glands have been cut out immediately after the death of the animal.

The **Honey-badgers** (*Ratelus* or *Mellivora*), of which two species are known, a smaller, indigenous in South and Central Africa, while the other larger species, which attains the length of from 24 to 28 inches, is a native of India, are, like the previous forms, nocturnal animals, which remain in excavated holes by day and roam about at night in search of their food. This consists mainly of honey, but also of birds, mice, tortoises, snails, locusts, and fruits. The honey-badgers seek out principally the underground nests of humble-bees and other species; but the nests of bees in hollow trees are not safe from them, for they are very good climbers. The head is shorter than in the former genera, the legs are short and adapted for burrowing, the tail is rather long; one premolar is wanting in the dentition; the long coarse fur appears as if divided into two parts. A light gray, almost white, mantle appears to cover the back from head to tail, while the rest of the body is black.

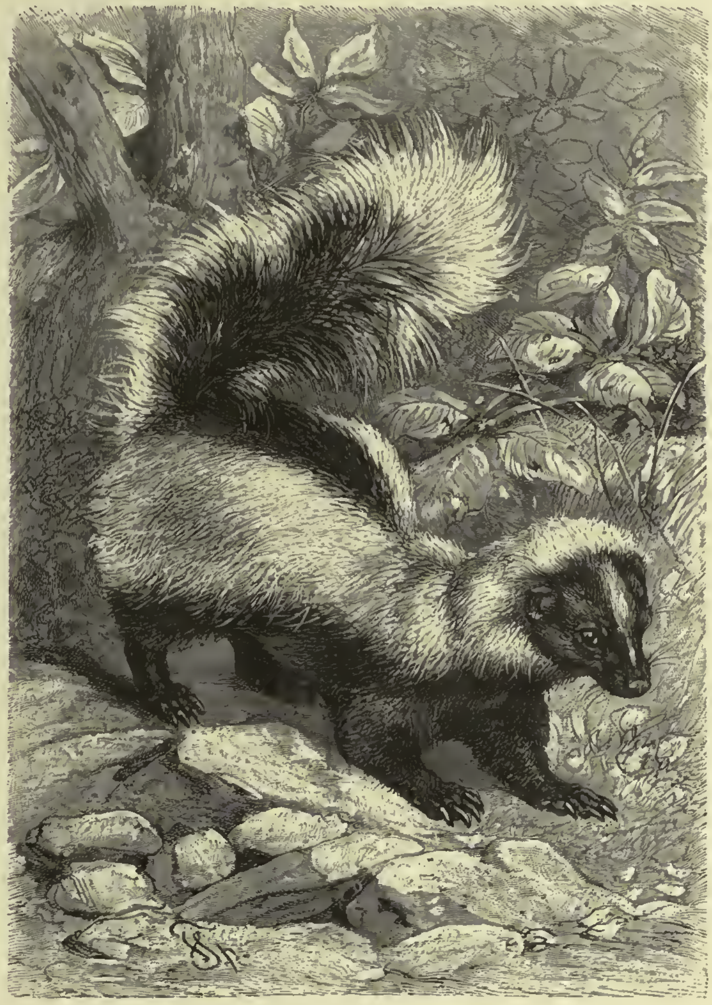


Fig. 111.—The Brazilian Skunk (*Mephitis suffocans*). page 218.

The honey-badgers, like the telagons, defend themselves by the diffusion of an intolerable odour. They appear, however, to be good-humoured, lively, and even tricky creatures. They are often seen in our zoological gardens, where they attract attention by their singular habit of running about in their cage and regularly, at a particular spot which they have selected for this exercise, standing upon their head.

I have seen a honey-badger in the Jardin des Plantes at Paris which repeated this process at the same spot a hundred times without getting tired. An illustration is given of the honey-badger known as the **Cape Ratel** (*Ratelus* or *Mellivora capensis*), fig. 110.

The **Skunks** (*Mephitis*) are small, very elegant, short-legged, but slender burrowers, which have a long naked snout and long bushy tail. Their fine soft thick fur attracts notice by its longitudinal white stripes, which form varied markings on the back. The ground-colour of the fur is always black. The variety in the white markings is so great that one can scarcely find two specimens exactly alike. The dentition is very much reduced by the loss of one or two premolars. Advantage has been taken of these characters to establish some sub-genera, which, however, have little value, for the nature of the teeth, among which the last tubercled teeth are very peculiar in their structure, remains always the same.

The skunks inhabit the whole length and breadth of America from Northern Canada and Hudson's Bay to Patagonia.

Notwithstanding their greater or less

diversity in appearance they have all similar habits. In the evening and at night they roam about in search of booty, which consists mainly of beetles and small birds, and by night they rest in trees or clefts in the rocks. The **Brazilian Skunk**, known under the name of Surilho (*Mephitis suffocans*), fig. 111, has only 32 teeth, while the **Chinga** of the Mexicans has 34.

The skunks fear neither man nor the most formidable beasts of prey. They can squirt the stinking yellow fluid secreted by their anal glands to the distance of several yards. When danger threatens them they turn round, erect their tail, protrude the anus, in order to expose the openings of the glands in the lower part of the gut, and squirt out the fluid, which diffuses such a frightful stench that every creature endowed with a nose recoils in a state of suffocation. This diabolical stench is so persistent that it resists washing with soap repeated daily for months. Fire and smoke alone can extinguish it.

Under the protection of this terrible weapon of defence the skunk feels itself secure against any enemy, even the jaguar. Only the most courageous dogs overcome the violent abhorrence excited by this pest, and dart upon the skunk to kill it with a bite. They then seek to get rid of the stench by rubbing their head and body in the earth.

GROUP OF THE MARTENS

(MARTIDA).

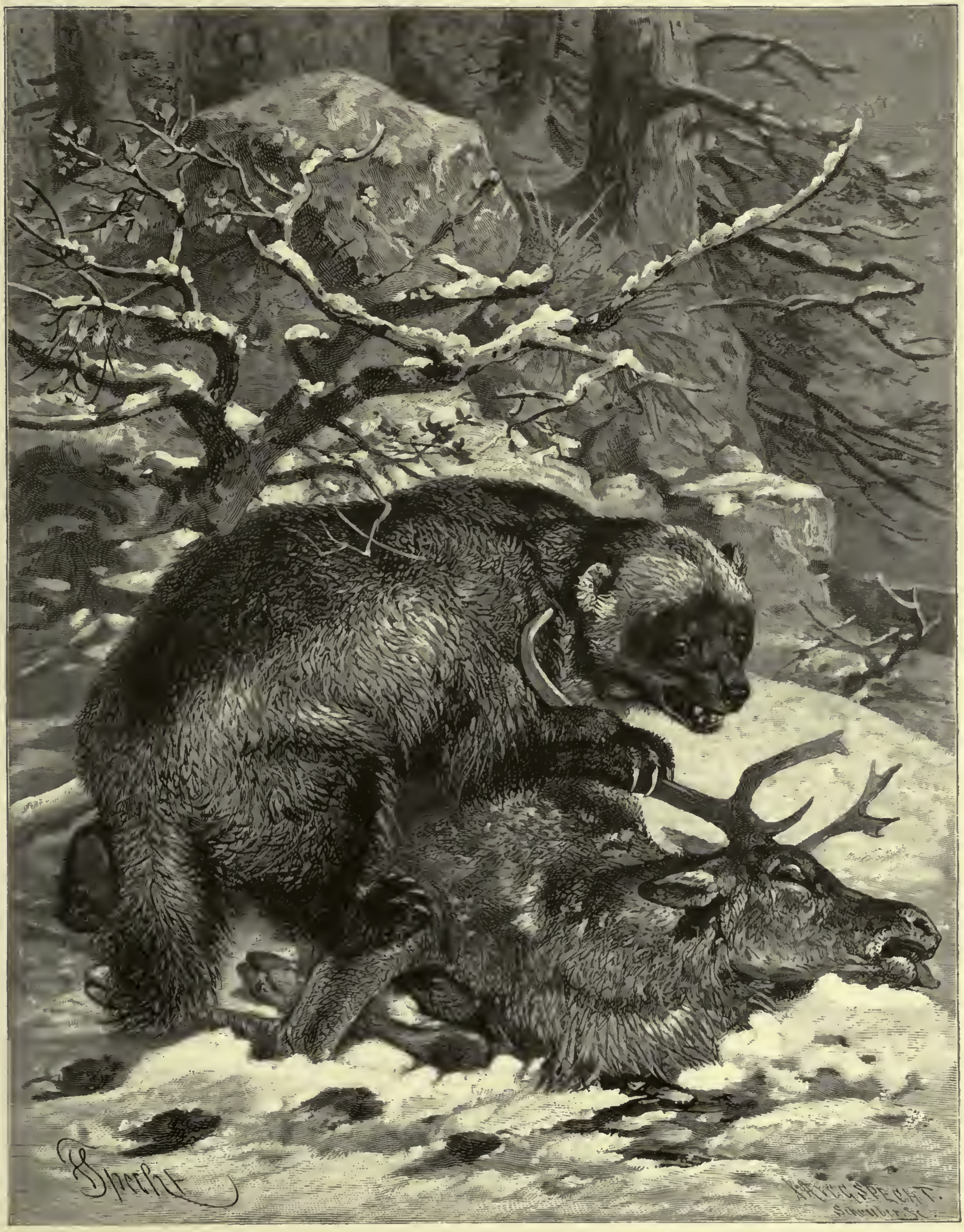
Mostly digitigrade animals, with long, and even worm-like body, frequently retractile claws, and usually a long bushy tail; the upper tubercled tooth small and transversely placed; the upper carnassial sharp, with a horizontal process in front. The transition from the previous to the present group is formed by some plantigrade members of the latter.

The **Glutton** (*Gulo borealis*), Pl. XIV., inhabits at the present day only the Arctic Regions of both hemispheres, while in Quaternary times it advanced to the foot of the Pyrenees and the Alps. The body is short and thickset, the head small and pointed, the legs pretty long, the feet five-toed and those of the fore-legs placed entirely on the ground in walking, while those of the hind-legs touch the ground for only half their length, the tail short and very bushy. As in the true martens there are in all 38 teeth, but the upper carnassial has no process in front, and the lower has only two cusps. The premolars are sharply pointed. The long thick glossy fur is of a chestnut-brown colour or even black, but the covering of the back is always bordered by a lighter fringe. Adult males grow to rather more than three feet in length.

The pious Bishop Pontoppidan of Bergen in Norway has told us the most wonderful tales of this Arctic carnivore. According to his account the glutton will sometimes eat so much that it is obliged to squeeze itself between two closely adjoining trees in order to get rid of the excess! The truth is that the glutton feeds on all that it can seize. It attacks even young reindeers, elks, and calves; but for the most part it must content itself with lemmings and other small rodents. Under the pressure of severe hunger it does not even reject carrion; but though at the moment when it scents its prey it betrays an inexpressible voracity, yet it does not actually devour more than sufficient to satiate its hunger, and it buries the remnants of its booty when too much for one meal.

It is found everywhere in the Arctic Regions, as well in woods as in stony deserts. I have seen it at the foot of the Sneehättan among the last pine-trees and in the naked wastes in the neighbourhood of the North Cape, where it may be observed trotting along in a very peculiar fashion, and yet with such speed that one could not follow it on horseback. It carefully avoids man because it dreads his weapons. Its formidable dentition enables it, however, to withstand the attacks of dogs.

The glutton sleeps in holes in trees or in



To face page 218.

Plate XIV. — A WOLVERENE or GLUTTON (*Gulo borealis*) attacking a reindeer.

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

rocks, but at irregular hours. It has no winter sleep. During the endless days and nights of the Arctic regions it may be seen ranging about at any hour. Since it is very wily and shrewd it is not easy either to catch it in traps or for the hunter to get near it. Cowering like a cat it lies patiently in wait for the large animals, which it seizes by the throat. Often it climbs on trees, and stretched out on a branch remains patiently on the watch for passing victims. It breaks into the uninhabited huts of the Lapps in order to revel on the stores.

The anal glands are but slightly developed, and only seldom, in case of the utmost danger, does it emit the obnoxious odour of which they are the source. When caught young it may be tamed to a certain degree, and affords amusement by its sports with those of its own kind. Its fur is little esteemed among us. The female brings forth in the month of May from two to four young ones, which it watches over assiduously and defends with courage.

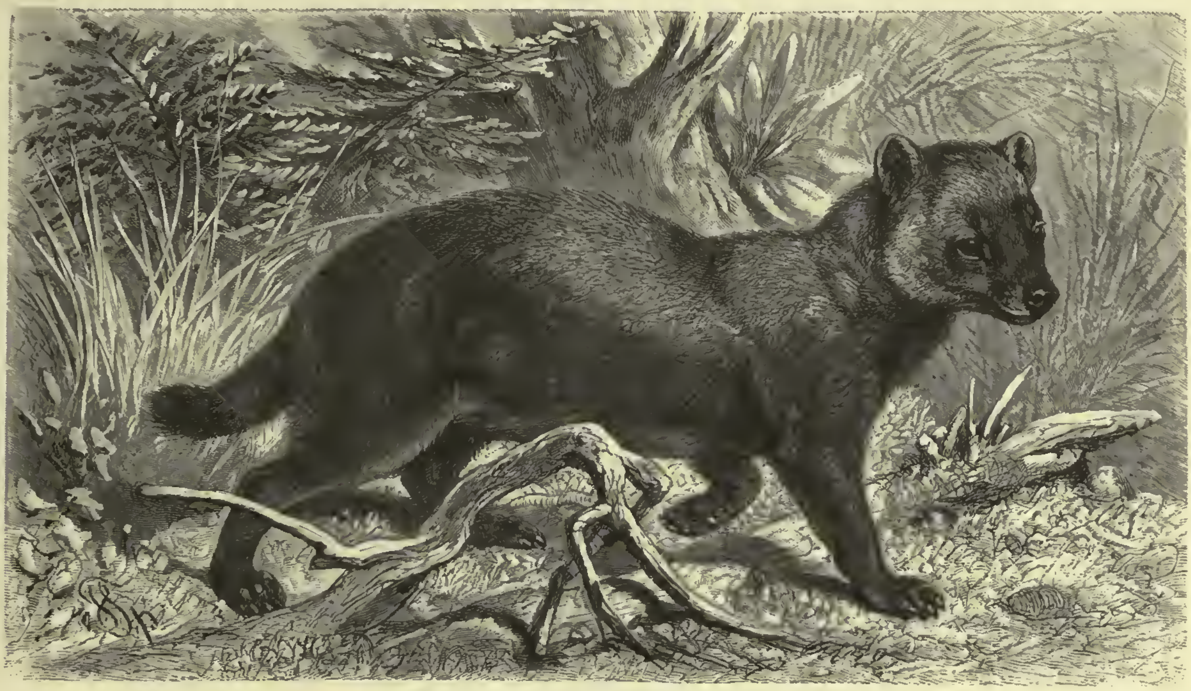


Fig. 112.—The Bush-dog (*Icticyon venaticus*).

A very remarkable form which was first discovered in a fossil condition in the caves of Brazil, and was shortly afterwards found living in the thickest parts of the primeval forests, is the **Bush-dog** (*Icticyon venaticus*), fig. 112, described by Lund. This very rare nocturnal animal is about the size of a moderately large, strong, thickset dog, which it somewhat resembles in appearance. It is of a brown colour, with a broad back, short strong legs, short tail, and pretty long-haired fur. The head is thick, the muzzle short and broad, the fore-feet with five, the hind ones with only four toes, all united at the base by a broad membrane. The animal has only one small tubercled tooth in each jaw, the carnassial teeth are short and with a small heel, the premolars pointed; but what mainly distinguishes this dentition is the great size of the carnassials and canines of the lower jaw. There are in all 36 teeth.

Not much is known of the habits of this very timid creature. It digs out holes, and appears to feed chiefly on birds and underground animals.

The **Hyrares** or Grisons (*Galictis*), which are distributed throughout South America, have altogether the appearance of weasels; a very long short-legged body, a short head thick behind, rounded muzzle, naked soles, sharp curved claws of moderate size, and long bushy tail. The scent-glands are fairly well developed. The teeth number 34 in all; the canines are very large, the premolars triangular, the carnassials sharp and powerful, the tubercled teeth small.

Of the two known species this work furnishes an illustration of the larger, the **Tayra** or Hyrare (*Galictis barbara*), fig. 113. The body attains the length of 2 feet or more, the tail about 6 inches. The colour of the fur is a beautiful golden-brown, inclining sometimes more to yellow, sometimes more to brown. A yellow spot, which becomes white on the dried skins, is seen beneath the throat. The smaller species, the **Grison** (*Galictis vittata*), attains the length of only 18 inches, and has a yellow colour on the back of the neck, the ears, and the tip of the tail, while the under parts of the body are almost black.

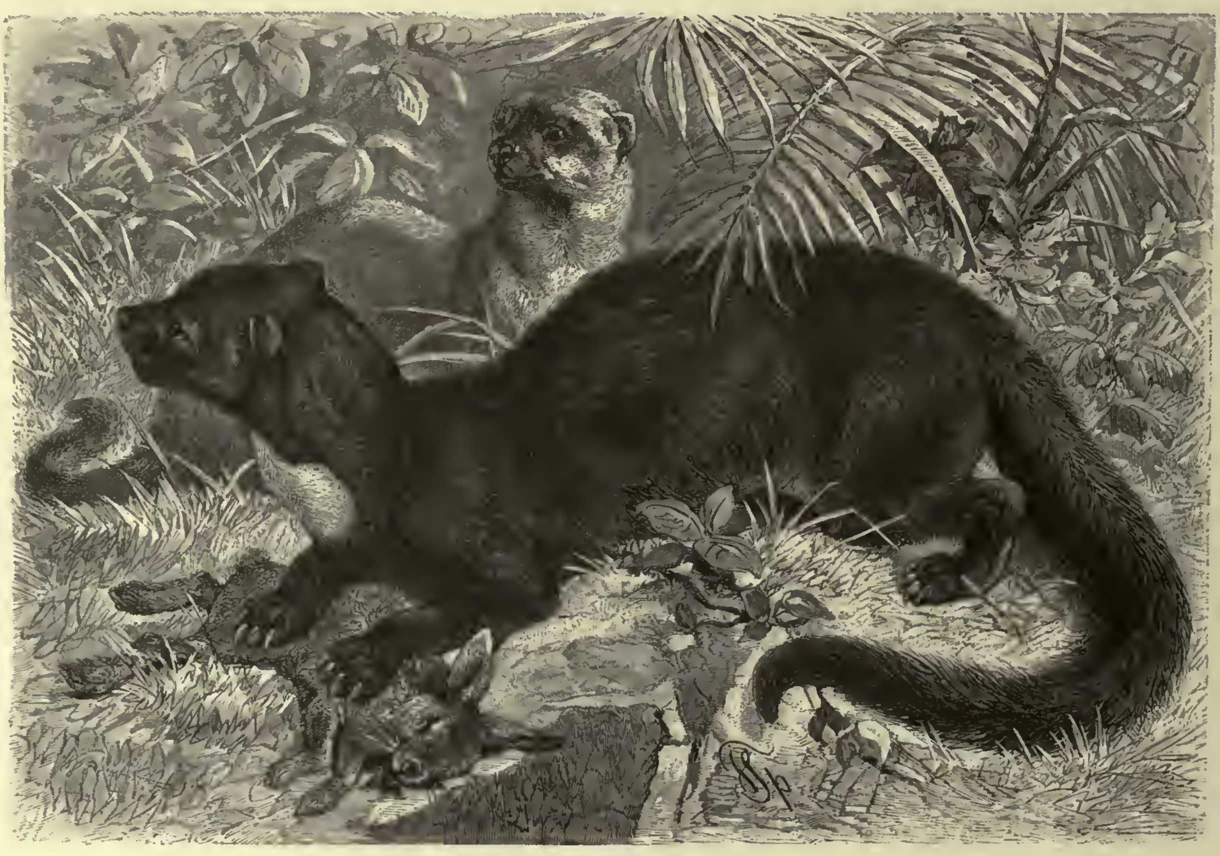


Fig. 113.—The Tayra (*Galictis barbara*).

The two species lead a similar life to that of our martens and weasels. The tayra prefers the forests, the grison open coppices and the vicinity of human dwellings. The agile creatures are capital climbers, and hunt game suitable to their size. Both have a decided preference for winged game, and often the despairing cry of the parrots betrays to the hunters the misdeeds of these fierce creatures, which are rather blood-suckers than flesh-eaters. They run, leap, and climb with extraordinary perseverance, and commit terrible massacres in the poultry-yards. They are hunted with dogs, which often surprise them in their holes, which are always made in the ground, or in other retreats; but they escape when they can, like our martens, to the trees, leap across the small branches from one tree-top to another, clamber down on the opposite side of a stem to that on which their pursuers are, scamper along the ground to another tree, and in that way lead the best dogs astray. Their fur is not highly valued. In some places they are kept, like our cats, to hunt rats and mice.

The **Martens** (*Mustela*) are distinguished from the polecats (*Putorius*) solely by their dentition. In all other respects these two genera, which are represented both in the Old World and the New, resemble each other very closely, and frequently they are combined, only the species being distinguished. Along with the otters these two genera furnish us with the most valuable furs.

The martens and polecats are small digitigrade animals, with very long, often worm-like body, very short legs, five-toed feet, with sharp claws on the toes, long bushy tail, head broad behind, and short pointed muzzle. These savage depredators hide in very carefully chosen retreats in hollow trees, clefts in the rocks, old decayed walls, and the like; and feed on the smaller mammals, on birds, eggs, reptiles, insects, and even on fruits when they can find nothing better. They are the boldest and most cruel ravagers among all the Carnivora, blood-suckers which kill far beyond the requirements of their hunger, expert climbers and jumpers, which often combine in a remarkable degree boldness and wiliness. The colder and severer the climate of their habitat the more valuable is their fur, especially when the animals have been killed in winter.

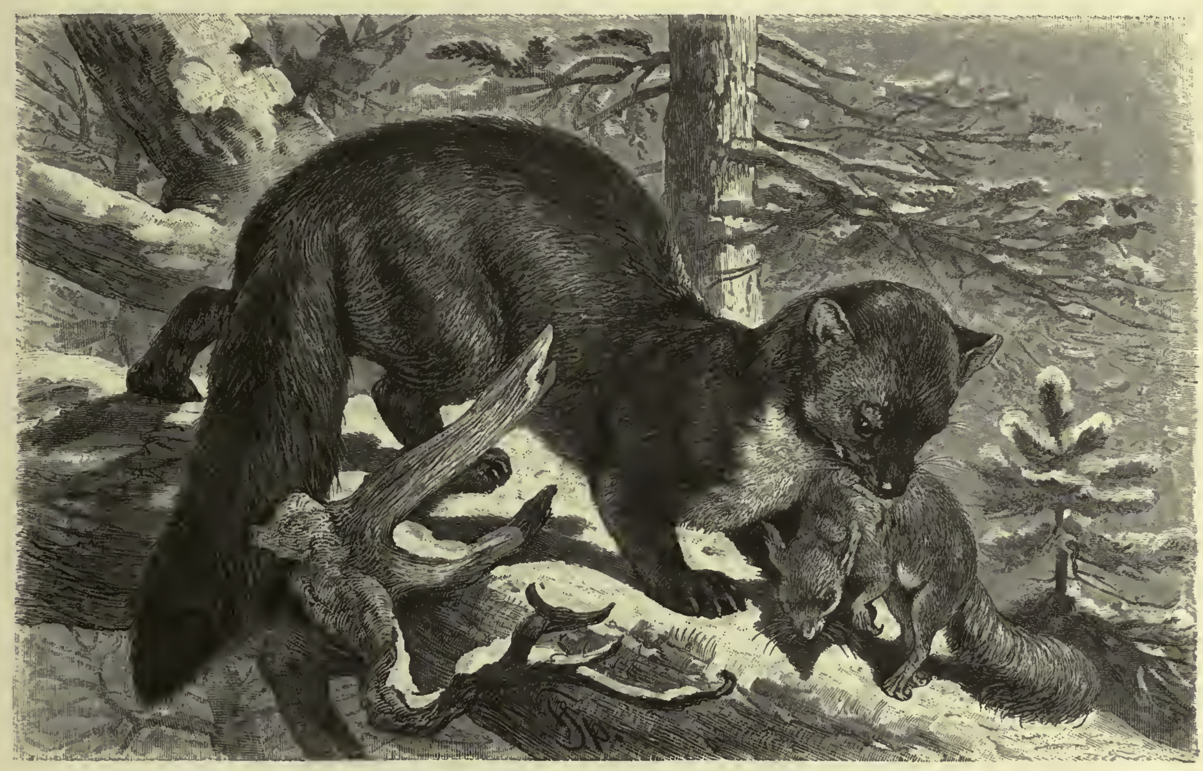


Fig. 114.—The Pine-Marten (*Mustela martes*).

The true **Martens** (*Mustela*) have 38 teeth in all, in the upper jaw four premolars, the last of which is a carnassial. The canines are slender, curved, and very sharp-pointed; the first premolar is very small, the upper carnassial long, sharp, with a narrow process in front, the tubercled tooth transversely elongated, while that of the lower jaw is small and round. In Europe we have two species of this genus. The **Pine-Marten** (*Mustela martes*), fig. 114, is brown, with an orange-yellow spot on the throat. As in all other martens, the fur consists of a very thick down, fine and soft, of a yellow and gray colour, with which are intermingled somewhat longer and stronger hairs of a brown colour, passing almost into black on the tail and legs.

The marten is distributed throughout Northern and Central Europe, extending as far as Italy and Western Siberia; its limits on the south-east are the Altai, the Ural, and the Caucasus. It is an inhabitant of the forests far from human dwellings, and makes its home in high trees, in clefts in the rocks, not infrequently in the plundered nests of ravens, falcons, pigeons, and squirrels. In unfrequented forests it hunts even by day; but where it fears any danger it goes out on its forays only by night. Birds, eggs, and mammals, as large, it may be, as the young of the roe-deer, are his favourite food, but he can satisfy himself in case of need with berries, fruits, honey, and insects. With respect to his climbing powers he is inferior only to the monkeys. Nothing is more delightful than to watch a marten pursuing a squirrel. The splendid rodent darts about with arrowy speed in wonderful leaps, and from time to time scurries down to the ground in order to climb up another tree; the ravager pursues with equal rapidity and at last overtakes his prey, though in many cases not till after a bewildering chase of several hours, and having caught him at once kills him and slakes his thirst in the blood drawn from the jugular veins of his victim. If in this case the marten remains the victor through his own rapidity and adroitness, he knows how to gain his end in other cases by patience and cunning. Cowering on a branch he awaits motionless the instant when he can dash unexpectedly upon an incautious victim not dreaming of any danger.

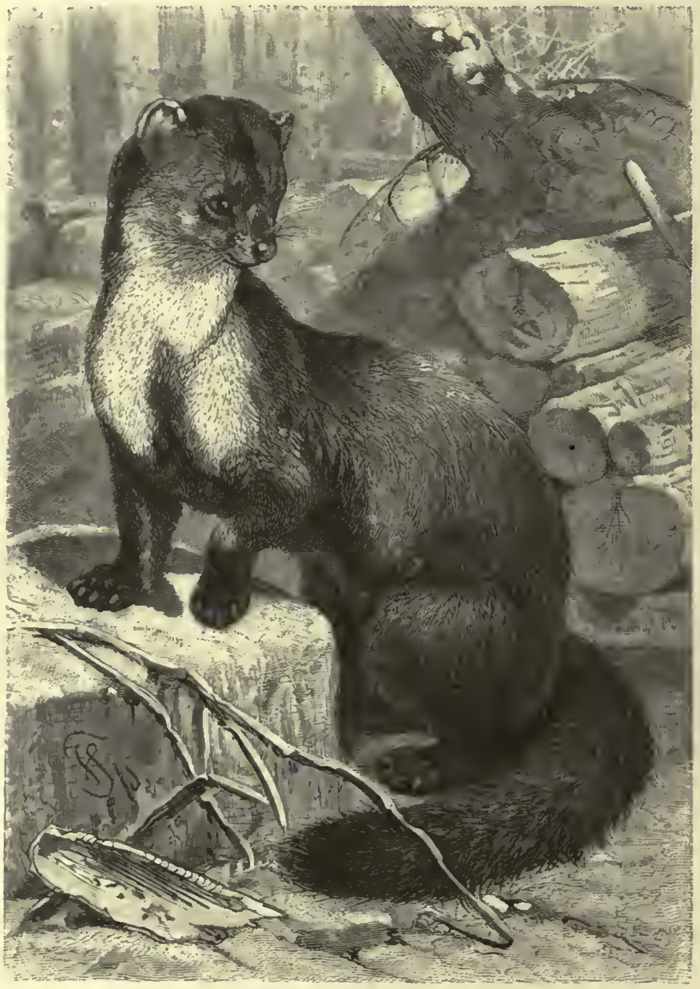


Fig. 115.—The Beech-Marten (*Mustela foina*).

The female brings forth her young in a warmly lined nest in April or May. From three to five are born at a birth. They remain blind for fifteen days, but can follow their mother at the end of two months.

The marten is hunted for the sake of his fur. He is caught in traps or snares, or his track is followed on the new fallen snow. Norway and the Highlands of Scotland yield the best furs, the finest specimens of which are almost as dear as that of the sable. The furs of Northern Germany and the High Alps are not so highly esteemed. Fur-dealers have, however, assured me that the few furs obtained from the elevated valleys of the Swiss canton of Valais and the Engadine may pass for sables and fetch as high prices when they are well dyed.

The **Beech-** or **Stone-marten** (*Mustela foina*), fig. 115, is to be found almost in all parts in which the rarer pine-marten is a native. But while the latter prefers the woods the former likes the vicinity of man, who furnishes him with a rich diet in his poultry-yards and dovecots. He makes his retreat chiefly in old walls, barns, deserted threshing-floors, under heaps of wood or stone, and keeps himself well hidden by day, carrying on his hunt only by night. In the course of his foray he often gets into noisy conflicts with the cats on the roofs. He is a good climber and a good swimmer, creeps about everywhere, and shows great circumspection in avoiding the traps and snares set to catch him, as well as in keeping out of the range of musket-shot designed for him. In certain districts where the beech-marten is not rare he is pursued by the proprietors with inexpressible fury; of all our native animals he is certainly the one that draws down the most fervent curses on his head. And justly too, for the beech-marten is, perhaps, still more bloodthirsty than the pine-marten, and when he has succeeded in making his way into a poultry-yard murders every living thing. Often he is found after such a nocturnal massacre sleeping in the midst of his slaughtered victims, as if intoxicated by their blood. Certain noises, for example, the filing of a saw or the sharpening of a scythe, can set the sensitive beech-marten so beside himself that he forgets his usual caution. This device is often resorted to in order to kill him. A man begins filing a saw in the vicinity of some well-known retreat of his, while another armed with a gun lies in wait for the animal, well concealed. The beech-marten, with hair erect, darts furiously out on the musician who tickles his ears so unpleasantly, and meets his death before he can reach him.

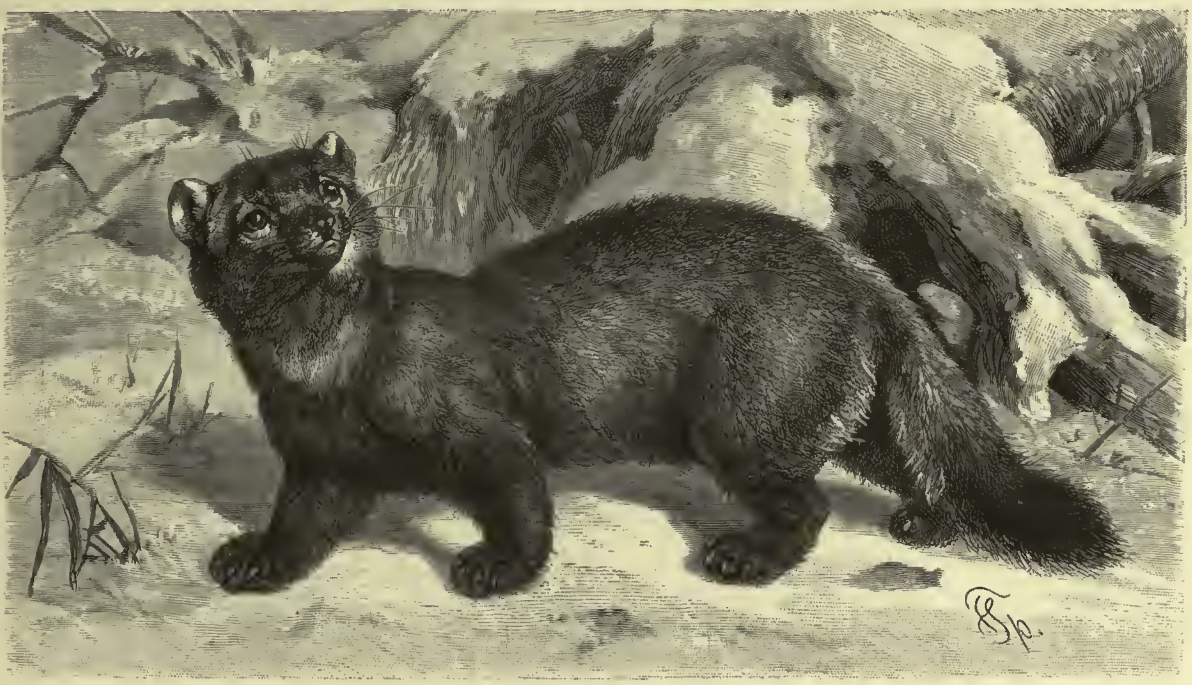


Fig. 116.—The Sable (*Mustela zobellina*).

The beech-marten is easily distinguished from the pine-marten by his grayer fur, the white colour of the throat-patch, by his longer tail, and also by some peculiarities in the structure of his upper carnassial and upper tubercled tooth. The young can be more easily tamed than those of the pine-marten. They become obedient and attached to their master, and even make themselves useful in houses by hunting rats and mice. The fur has a much lower value than that of the pine-marten.

The **Sable** (*Mustela zobellina*), fig. 116, is the king of the martens on account of its extraordinarily soft thick fur, which appears of a blackish colour on the back and feet, and exhibits an ill-defined yellowish patch on the throat. The down is grayish yellow inclining to red. Many varieties of colour are met with. The darker the colour and the glossier the hair, the more costly is the fur. Although the sable is no larger than our marten, £24 is paid on the spot for a fine black sable-fur. The largest sables attain a length of 18 inches.

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

The sable is easily distinguished from our martens, not only by the characters derived from the fur, but also by its larger rounded ears, its shorter tail, and by having the soles of its feet covered as it were with a brush of stiff hairs, which facilitates the progress of the animal on the snow. With respect to the skull and the dentition the sable approaches most nearly to the beech-marten, while its mode of life most resembles that of the pine-marten.

The sable is found in all the cold and mountainous regions of Siberia from the Ural to Kamchatka. The numerous squirrels of these regions form its principal food. Formerly very abundant it has been driven by man more and more into the wildest districts of his extensive domain. It is hunted only during the cold season. Even at the present day some districts still pay their taxes in sable-skins. The dearest are obtained by the trade from the neighbourhood of Yakutsk and Okhotsk, and from Kamchatka. The sable is caught in traps and snares, or is hunted on the snow, the hunters wearing snow-skates, and being accompanied by dogs, with the aid of which they endeavour to chase it to some isolated tree, whence they shoot it down with blunted arrows so as not to spoil its fur. The total annual yield of furs in Siberia is estimated at 100,000, but this number is decreasing every year.

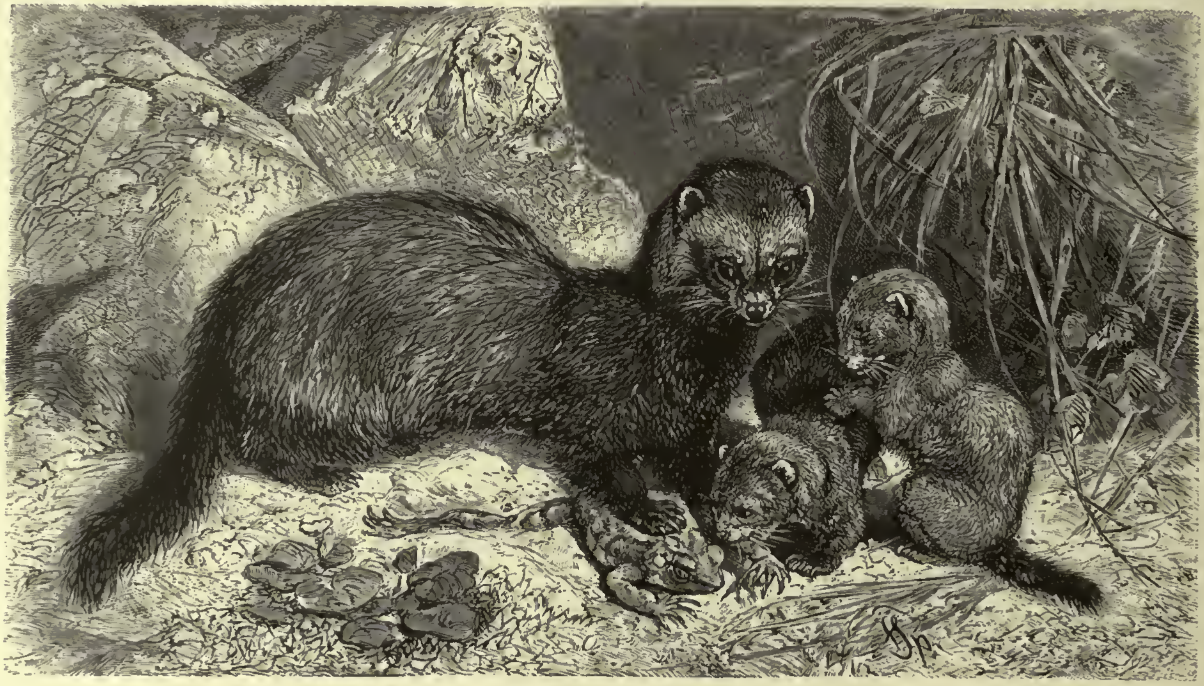


Fig. 117.—The Polecat (*Putorius fœtidus*).

North America possesses two species of martens, the skins of which are reckoned as of about equal value to those of the pine-marten. One of these species, the **American Marten** or Huron (*Mustela americana*), is, perhaps, only a variety of our form; the other, the **Pekan** or Canadian Marten, attains the size of a fox, which it also resembles very closely in form.

As already mentioned, the **Polecats** (*Putorius*) are distinguished from the martens by their reduced dentition, the whole number of teeth in them being 34. The polecats have, in fact, one premolar less in each jaw. The sharper carnassials and the narrow upper tubercled tooth indicate a still more bloodthirsty character if possible than that of the martens, from which the polecats are further distinguished by their longer body, shorter legs, and the tolerably large size of the anal glands. The polecats, in fact, make use of their stink-pouch as their last means of defence.

In this genus, comprising a large number of species, three groups may be distinguished by the variations in the distribution of the colours of the fur: the **True Polecats**, the **Weasels**, and the **Visons**. The characters of these groups are easily recognized. The polecats have the sides and back lighter than the under side; in the weasels, on the other hand, the back is darker, the under side very light; the visons, lastly, are pretty uniform in colour, but have the under side a little lighter than the rest of the fur.

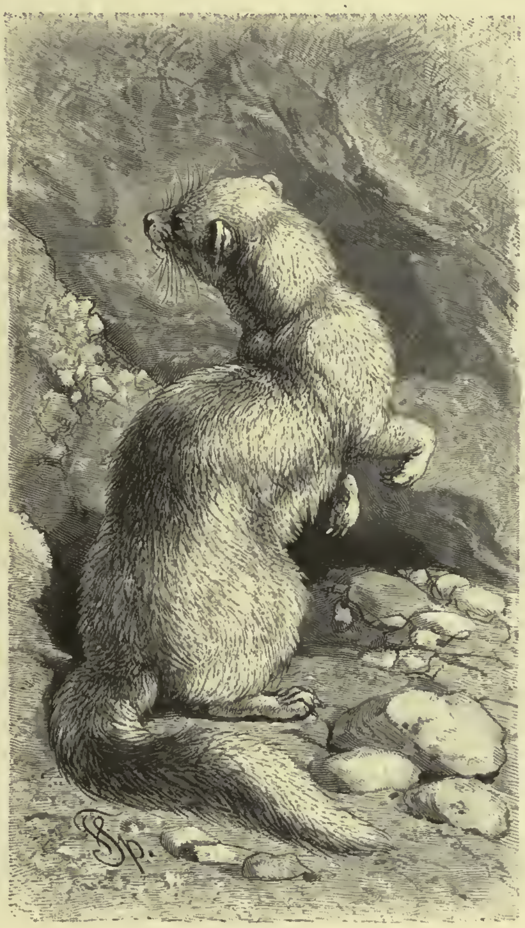


Fig. 118.—The Ferret (*Putorius furo*).

The **Polecat** (*Putorius fœtidus* (*Mustela putorius*)), fig. 117, does not quite attain the size of the beech-marten, which it resembles very much in its mode of life. Like it the polecat prefers to live near human habitations, where it can find secure retreats. It commits the same kind of massacres, is no less cunning and adroit, and is not less detested, at least in certain districts. In other districts, on the contrary, the services which it renders in the destruction of mice, rats, field-mice, and even hamsters, are highly prized. Since it hunts only at night the poultry-yards may, in case of necessity, be defended against him, so that the slaughter of a few domestic fowls does not outweigh his services in the fields and barns. But since he is fond of laying up stores he makes himself hated, not only on account of his own bad smell, but also because of the stench of the larder which he keeps in his hiding-places.

One other quality distinguishes the polecat. While the beech-marten eats reptiles only in cases of the utmost need, the polecat appears to be very fond of lizards and serpents as well as frogs. Experiments have shown that he possesses the same power of resisting the poison of vipers as that which the hedgehog enjoys. Vipers, whose bite would infallibly have killed a dog, did not do the slightest injury to a polecat, which finally devoured them after a hard battle. The tenacity of life otherwise displayed by these animals is very great and known to all hunters.

The polecat inhabits the same regions as the beech-marten, but does not venture into northern lands, preferring temperate regions. His fur, dark brown underneath, brownish yellow on the sides and back, is much inferior in value to that of the marten. The downy hair is, indeed, just as fine and soft, but the bristly hairs are longer and coarser. The horrible stench, which can only with difficulty be removed, is also a cause of its lower value. Germany, and especially the Bavarian plateaux, yield the best specimens. The animal is hunted in the same way as the beech-marten, and he shares the sensitiveness of the latter to harsh metallic sounds.

The **Ferret** (*Putorius* (*Mustela*) *furo*), fig. 118, is only a trained variety of the polecat, with white or yellowish fur, rather darker underneath, and red eyes. Like all albinos the ferret is less lively and has less power of resisting external influences than his kindred; it is more sensitive to frost and damp, frequently becomes ill, but is just as bloodthirsty as the polecat. It is probable that this race of albinos was developed in Greece and Italy, where the polecat in ancient times took the place of the cat as a mouse-catcher, and that the race which had in that way become more familiar with man continued to be bred for the hunting of rabbits. Aristotle was acquainted with the ferret, and the Emperor Augustus sent some to the inhabitants of the Balearic Islands and Spain, who could not protect themselves against the ravages committed in their fields by rabbits. The ferret is known only in a half tame condition, and it is still used in hunting rabbits, but also, for the sake of sport, to fight with large rats. Snares are set across the mouths of the passages leading out of rabbit burrows, and the spirited little animal, with a small bell attached to it, is then allowed in. The rabbits, mad with terror, take to flight as soon as they hear the bell, and are caught in the snares. It is necessary, however, to muzzle the ferret, for otherwise it would at once devour the first rabbit in which it could set its teeth, and then sleep out the period of digestion in the burrow, putting the patience of the rabbit-catcher to a hard trial.

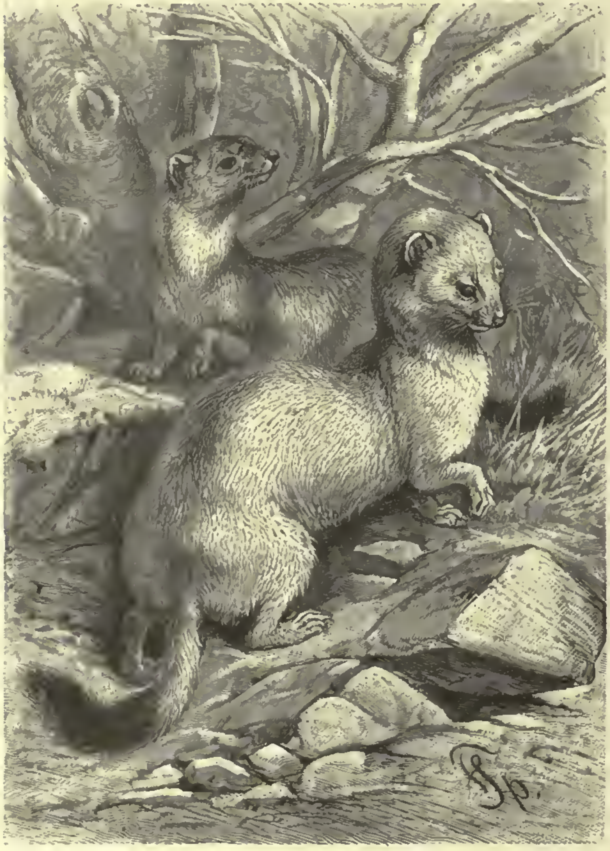


Fig. 119.—The Common Stoat (*Putorius erminea*).

Another species of polecat is known in the south-east of Europe, extending as far as the Caucasus. This is the **Tiger Polecat** (*Putorius sarmaticus*), a species with yellow spots and stripes on a fur of a darker colour generally. It hunts chiefly the bobaks, the small marmots of these regions. The fur is little esteemed.

The **Weasels**, of which the sub-genus Gale has been formed, are distinguished by their long worm-like body, very short legs, and the colour of their fur, dark on the back, very light underneath. The numerous species are found in both hemispheres, as well in the north as in the torrid zone.

Notwithstanding their small size the weasels are probably the most courageous and bloodthirsty of all carnivores. They live among heaps of stones, in clefts in the rocks, and in general wherever they can find a hiding-place, and they carry on their hunt by day as well as by night. Two native species are shown in the illustrations.

The **Common Stoat** or Ermine (*Putorius* (*Mustela*) *erminea*), fig. 119, is one of the larger species of weasels, attaining the length of 10 inches with a tail of four inches.

Like most animals belonging to northern regions the stoat changes its colour with the season, and this it does even in our temperate zone. In winter it is perfectly white, except that there is a yellow shimmer underneath and a beautiful black tuft at the tip of the tail. In summer it is of a bright chestnut-brown on the back and sides, yellowish white on the belly, and quite black on the inner sides of the paws and at the end of the tail. It is an unwearied destroyer of rats, mice, and field-mice, young rabbits, hares, partridges and fowls, frogs, fish, and crabs.

The ermine knows no danger; it attacks even man, or at least offers an obstinate resistance to him. If it cannot consume its prey it licks up its blood. The almost incredible boldness of this little animal is combined with much cunning and caution. Sometimes several ermines unite in order to render each other assistance in mastering a larger animal. Since it is small the ermine is of use to the farmer in destroying vermin; if it were larger it would be the most dangerous enemy man had to fear.

The wearing of the fur of the white ermine, on which were fastened the black terminal tufts of the tail, was formerly regarded as a prerogative of princes. Now this fur is very much out of fashion. The ermine is hunted in winter for its fur in northern lands. The skins of our ermines are worth nothing.

The **Weasel Proper** (*Putorius* (*Mustela*) *vulgaris*), fig. 120, is still smaller than the previous species. The body is eight inches in length, and the very short tail, which has no tuft, scarcely two inches. The weasel is of a chestnut-brown colour with a reddish shimmer on the back, white underneath, and does not change its colour in the winter The little creature advances no further north than the south of Sweden, but on the other hand makes its way much further south than the ermine, and is found all along the northern shores of the Mediterranean. Its life, its habits, and its qualities are in no respect different from those of the ermine, only it attacks smaller animals. Before the introduction of the cat it was used by the ancient Greeks, like the polecat, as a domestic animal for the hunting of mice.

The **Visons**, which have been united in a sub-genus under the name of Lutreola, approach the polecats in their general organization, but are distinguishable by the uniform brown colour of their short, thick, glossy fur, by their stouter, although still rather long body, by having a very large and massive tubercled tooth in the upper jaw, by their longer and more bushy tail, and their shorter legs, the toes of which, especially on the hind-feet, are united by a web extending to the root of the short claws. The ears are very short, the muzzle rounded and blunt. The anal glands, so highly developed in the polecats, are not indeed altogether wanting, but are very unimportant. Only in cases of the utmost need do the visons diffuse a very disagreeable smell. At other times their smell is not indeed pleasant, but still no worse than that of most other carnivores.

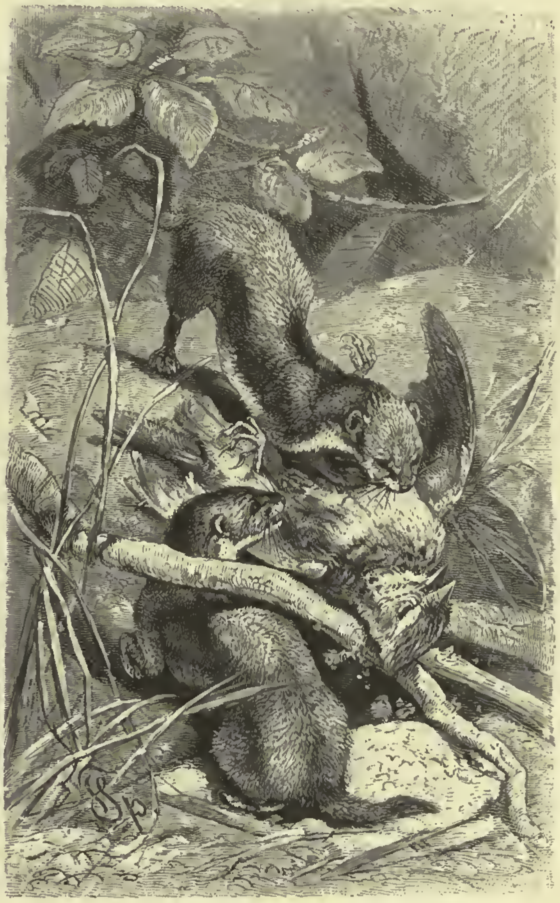


Fig. 120.—The Weasel (*Putorius vulgaris*).

The visons are a transitional form between the martens on the one hand and the otters on the other, and the habits, practices, mode of life, and kind of food correspond to this intermediate position between two otherwise well-defined types. The visons, in fact, live more in the water than on the land. Low-lying tracts of land, marshes, thickets on the banks of rivers, rivers themselves, lakes, and ponds are the places where they seek their food and make their retreats. They swim and dive easily and perseveringly, run and jump on the land pretty well, climb very little and never very high, hide in deserted burrows of rodents which, perhaps, they have devoured, and in clefts in the rocks on the borders of the water, and feed on everything that opportunity offers. But without doubt they prefer fishes, frogs, crabs, and mussels to aquatic birds, water-rats, and field-mice. This mode of feeding explains also, as our otters prove, the large size of the tubercled teeth, which we mentioned in speaking of the dentition. These do not in the least indicate a vegetable diet, as would be the case in a land animal, but serve for the crushing of the hard external skeletons of certain aquatic forms—mussels and crustaceans.

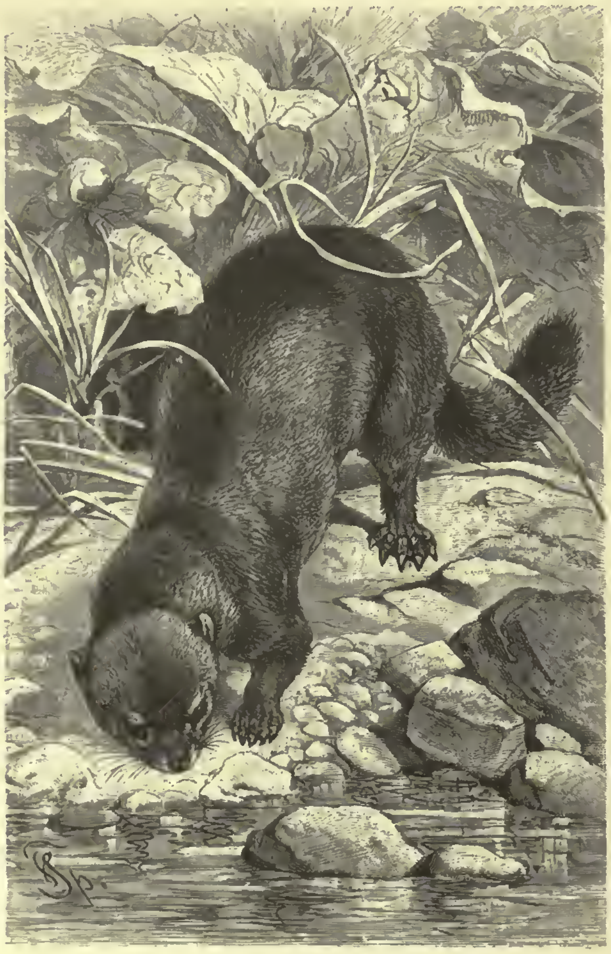


Fig. 121.—The European Vison (*Putorius lutreola*).

With respect to keenness of scent, boldness in attack, persistence in pursuit, and stubbornness in defence, the visons are inferior neither to the martens nor the otters. It would appear, however, that their intelligence is less highly developed. They allow themselves to be caught even in the rudest traps, when these are baited with a piece of duck's flesh or the thigh of a frog, and if the trap has caught them by one leg, they gnaw away the limb on the wrong side, while the fox and marten know how to liberate themselves by biting through the captive paw between the trap and the body.

When caught young visons can easily be tamed. If well cared for they become attached to their owner and obedient. In America they have sometimes been trained for rat-fighting, as has been done with the ferret in Europe.

Visons are natives of the Arctic regions and northern parts generally. Naturalists are not agreed as to the distinguishing of the species. Some make three distinct species: the **Siberian Vison** (*Putorius sibiricus*), confined to Eastern Siberia, with yellowish-brown fur, long bushy tail, and whitish feet; the **European Vison** (*P. lutreola*), fig. 121, of the size of a ferret and of a brown colour with white spots on the nose, found in the north-east of Europe from the Weser to the Ural; and the **American Vison** or Mink (*P. vison*), which is larger and has no white spots. Other naturalists maintain that these three species are only more or less well-marked varieties of a single circumpolar species, which has advanced here and there into the temperate zone. It is certain that there are intermediate forms. In commerce the skins of the American visons are the most highly esteemed, ranking next after those of the sable in price, an estimation which is perfectly justified by the beautiful chestnut-brown colour of the fur, the softness of the thick down, and the glossiness of the stronger hairs which scarcely project beyond the down.

We mention here a small member of the

Mustelida belonging to Patagonia, the **Lynx-tooth** (*Lyncodon patagonicus*). fig. 122, which is remarkable for the extraordinary diminution in the number of its teeth, of which there are no more than 28. The sharp incisors have the normal number, six in each jaw, the canines are strong, scarcely curved, very long and very sharp; but in both jaws there are only two premolars. In the upper jaw the second premolar is a very sharp carnassial with a narrow heel, and this is followed by a small transversely placed molar which is not at all tubercled, and may almost be said to be sharp. In the lower jaw there are two pointed premolars and a molar, which is a five-pointed carnassial. The tubercled tooth is altogether wanting. The dentition accordingly has two molars less than in the cat tribe, the same number as in the lynxes, whence the name. On a small scale this dentition somewhat resembles that of the fossil Machairodus, and presents a remarkable instance of the approximations that may be brought about between two families through the reduction of the number of the teeth.

Till recently nothing was known of this animal but the skull, which was described by Gervais. Now the museum at Geneva possesses two stuffed specimens brought from Patagonia, and from these our drawing was made. Except for its dentition the animal is a true weasel, somewhat larger than the stoat. The body is about twelve inches in length, the tail scarcely four inches. The fur is rough, coarse, formed of long, thinly scattered bristly hairs, which on the back are of a bright brownish-red, but on the sides and tail have whitish points. The upper part of the head is of a dirty yellowish-white colour, and this colour is continued backwards across the ears on two tufts composed of long hairs lying on the sides of the neck, each tuft running to a point. The nape and upper part of the neck, as well as the throat and paws, have a rather dark brown colour. The tail is clothed with very long hair, ending in a tuft. The head is short, the muzzle blunt, the ears very small, rounded, and broad, the feet five-toed, those of the hind-legs touching the ground with the entire sole in walking, those of the fore-legs only with half the sole, the toes bearing short sharp claws. Nothing is known of the habits of life of the animal. Judging from its dentition it must be purely carnivorous.

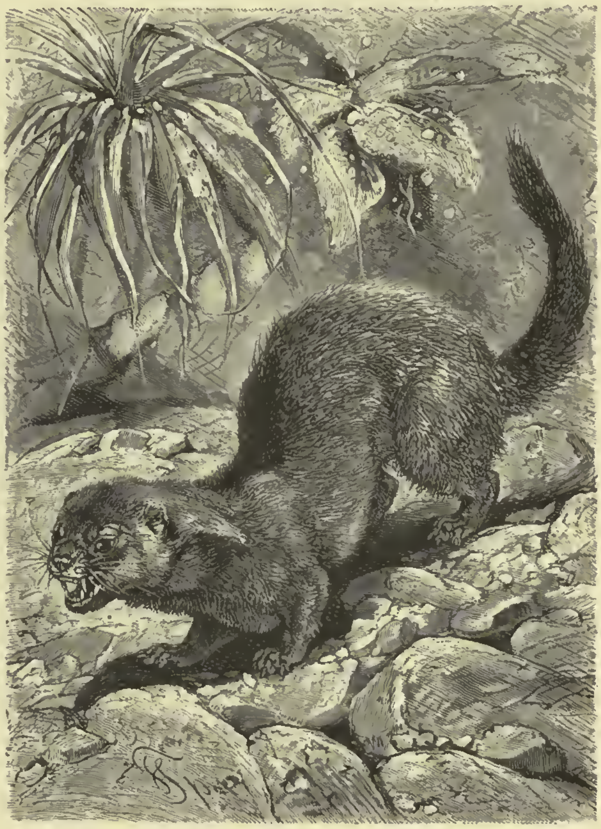


Fig. 122.—The Lynx-tooth (*Lyncodon patagonicus*).

GROUP OF THE OTTERS

(LUTRIDA).

Aquatic Mustelida with long, but stout, cylindrical body, short webbed feet, and flattened tail.

Our European **Otter** (*Lutra vulgaris*), fig. 123, may serve as the type of a considerable number of species which are distributed throughout all lands inhabited by Carnivora, and for the most part frequent fresh water. Founding on very insignificant points of distinction, naturalists have allotted these species to a pretty large number of sub-genera.

which we will not mention, since the essential characters are throughout the same in all.

The common otter, whose domain extends over the whole of the Eurasian continent, between the Arctic Circle in the north and the Himalayas in the south, and embraces even Japan, has a broad flattened head, with short blunt muzzle, on the end of which there open at the sides the slit-shaped nostrils, which can be completely closed when the animal dives. The lips are very thick, and set with long twisted moustaches; the eyes small, placed close together on the upper surface of the head, the ears very short and rounded. The moderately long neck is almost as thick as the head, the body cylindrical; the pretty long and easily compressed tail ends in a point; the legs are very short, but strong; the paws somewhat crooked, almost as in the badger-hound, the five toes almost of equal length, and the feet completely webbed, the claws very short. An adult otter may attain the length of 2½ feet or more, while the tail measures half that length.

The total number of the teeth is 36. The incisors are short, almost equal in size; the canines massive, somewhat recurved. In the upper jaw there are four premolars, the first of which is very small, and placed on the inner side of the canine, not behind it, while the last premolar is a carnassial with a single sharp cusp, and a very broad low heel. The permanent molar with tubercled grinding surface is enormously larger than all the other teeth. In the lower jaw three conical premolars, the smallest of which is in front and the largest behind, are followed by a carnassial with three sharp conical cusps in front, and a strong posterior heel, while this again is succeeded by a rounded tubercled tooth.

The fur, which is pretty highly valued in trade, is thick and short; glossy and rather stiff long hairs cover a very soft down. The colour is a beautiful dark chestnut-brown on the back, but rather lighter underneath.

Of all our native animals the otter is certainly the most intelligent, that which makes best use of the lessons taught by experience. Its scent is infinitely delicate, its hearing exceptionally keen. The otter is an active, lively, spirited, and strong animal. Its element is the water. It is a most expert swimmer and diver; it swims easily against the most torrential currents, and is in no way inferior to the trout and the pike in rapidity and flexibility of movement. Young cats playing on the ground are only awkward sprawlers in comparison with young otters plunging about in the water.

The otter lives on the edge of streams among the shingle of the banks, in deserted foxes' holes, or in holes dug out by itself. In most cases the passage leading out of these holes opens at a certain depth below the surface, while one or more passages opening above serve for ventilation.

When I lived in the district of Souterre, at the junction of the Rhone and the Arve, in the neighbourhood of Geneva, I became well acquainted with an otter which lurked among the large blocks of stone on the edge of the water. Every night it used to swim up the Rhone to the slaughter-house of the town, where it found abundance of fish and crabs. Often I met it at night by moonlight on a shady path which ascended along the river-bank. The first few times it met me it vanished with lightning speed in the water; afterwards, when it had observed the course I took, it merely stepped aside among the bushes to let me pass. Plainly it knew that I did not want to do it any harm. I often found its evacuations on the path, and examined them. They were of a chalky white colour, like those of dogs, and contained fish-bones and fragments of the shells of crabs, never anything else that I saw.

Fish and crabs are, in fact, the favourite food of the otter. But it also consumes small mammals, birds, frogs, and, in short, everything that lives in and near the water.

RSITY

In a state of freedom it is certainly exclusively carnivorous, but in captivity it can easily be accustomed to a vegetable diet.

The otter lives a solitary life. The breeding season, which interrupts its solitariness for a time, mostly occurs at the beginning of spring. The female gives birth in May to at most four blind young ones, which she watches over tenderly, and keeps for a long time under her guardianship.

Although otters are rather helpless creatures on land, they yet sometimes traverse long stretches of country to get from a dried-up brook to another still running. They waddle along pretty quickly with their belly on the ground. They can easily be tamed, become much attached to their master, following him like a dog, and allow themselves to be trained for fish-catching.

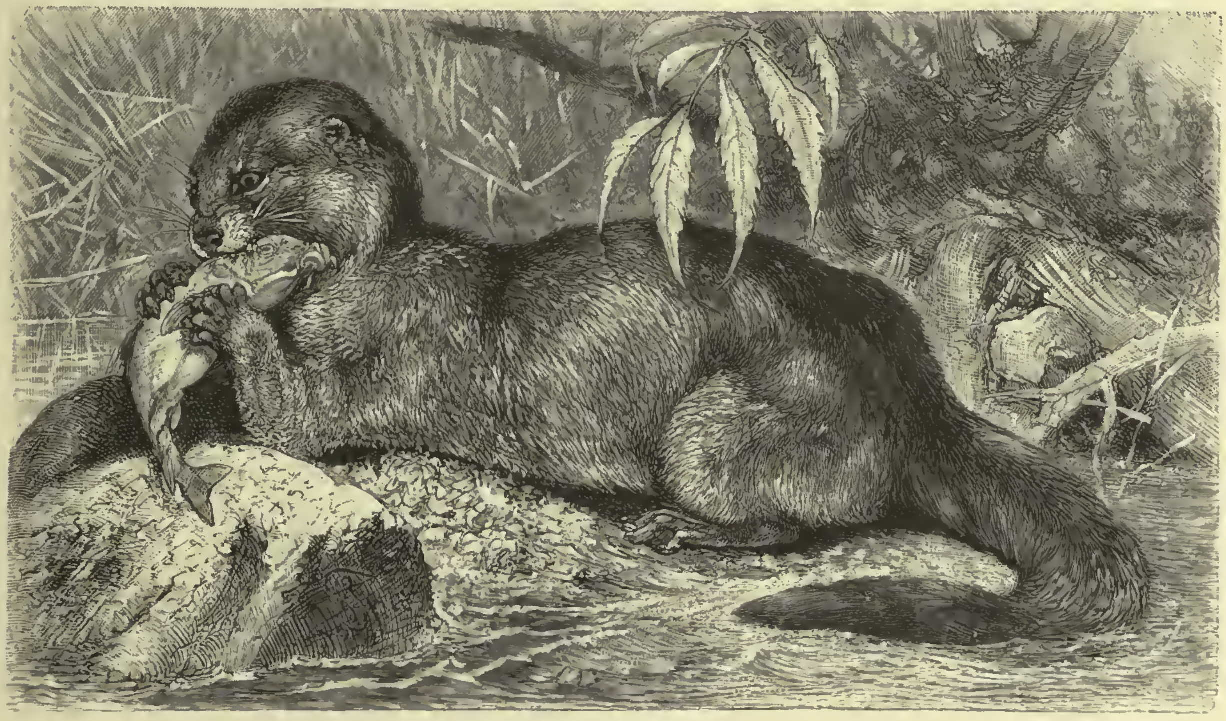


Fig. 123.—The Otter (*Lutra vulgaris*). page 229.

Yet the otter is passionately pursued on account of the devastation it commits among the fishes in ponds and rivers, as well as for the sake of its fur and its tender tasty flesh, which is among the articles of diet allowed during fasts. In the eyes of the Church the otter is a fish. But the hunting of the otter is extremely difficult. In the water the animal merely shows the point of its nose for an instant to breathe. Traps it avoids with great astuteness, and it detects at once by the smell whether a human hand has touched them; and when it has been caught by a single paw it bites itself free and makes off.

The Sea-otter (*Enhydris marina*), fig. 124, is rightly considered a peculiar type, which forms the connecting link between the otters and seals. It is a powerful animal, attaining a weight of about 90 lbs., and a length of nearly 4 feet. The species is absolutely confined to the shores of Behring's Strait.

The head is quite round, the neck thick and short, the body thick and cylindrical, the tail short and flattened like an oar, the feet very short and clumsy. All the feet are broadly webbed, and thus form powerful oars; the fore-paws are small, the toes completely covered with hair, and only indicated by very short claws; the hind-legs are placed very far back, and are long and broad, shaped in fact almost like those of seals.

The dentition is very remarkable. The sea-otter is the only carnivore which has only four incisors in the lower jaw, while in the upper jaw there is the normal number, six. This state of matters is found even in the milk dentition. The canines are large, but not so massive as in the common otter. The rest of the dentition has the same formula as that of the polecat: three premolars above and below, one true molar above, two below. There would thus be in all 34 teeth if the loss of a pair of incisors in the lower jaw did not bring the number down to 32. But, as regards their form, these teeth are very different from those of the martens; for the cheek-teeth, carnassials as well as molars, are all tubercled, with broad, flat crowns, and have so completely lost the character of carnivorous teeth, that one who found them separately would have no hesitation in ascribing them to an omnivorous animal.

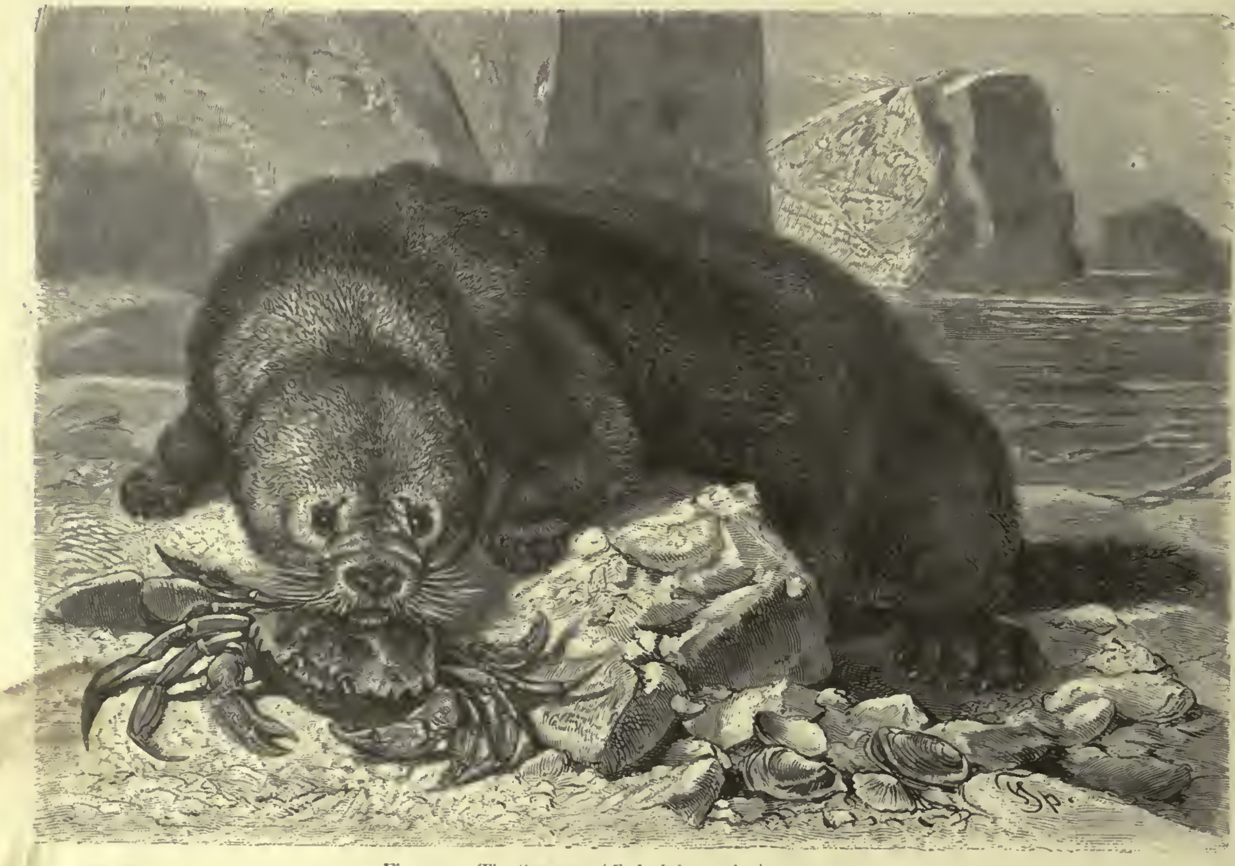


Fig. 124.—The Sea-otter (*Enhydris marina*). page 231.

It is easy to recognize in this structure the result of a special kind of diet. The sea-otter feeds, in fact, almost exclusively on crustaceans (crabs, &c.) and mussels, whose hard shells it crushes to pieces. Only exceptionally does it consume fish when they fall in its way, never hunting after them.

Since the sea-otter inhabits the parts of the Arctic regions bordering on the Pacific Ocean, it spends almost the whole of its life amid snow, ice, and ice-cold water. To this coldness of its habitat it no doubt owes its wonderfully beautiful brown, almost black fur, with a silver-gray shimmer in old animals. It is not so much a fur as a warm, flexible, highly finished natural velvet, the down of which is soft as eider-down, while the short and thick bristly hairs keep out the water completely. According to my own private taste, the fur of the sea-otter is the finest in the animal world, and far excels that of the sable. In commerce, however, the skin of the sable is more costly than that of the sea-otter.

Towards the end of last century the sea-otter was still pretty abundant on the coasts of the islands in Behring's Strait and those of Kamchatka and northern California, but it seems likely soon to disappear entirely in consequence of the senseless pursuit carried on against this gentle and intelligent animal.

Steller, who suffered shipwreck on Behring's Island in the middle of last century, and was there obliged to support himself and his companions in misfortune for a year at the expense of the numerous sea-otters, has given us an account of this animal before the appearance of man. A truly idyllic picture! The mothers play with their young ones, follow them to their death, and pine away over their loss. The males caress the females tenderly. The societies live in perfect harmony, bask in the sun, and lead a careless and happy life. They sleep without fear in the vicinity of man, rolling themselves up like dogs. They show themselves annoyed when their retreat to the sea is cut off, scarcely defend themselves against attack, caress even the hand of the man who is preparing to strike them dead, and roguishly feign death when they have received a stroke, getting up afterwards and making their escape when one's back is turned. At the end of a year of continuous massacre, in the course of which more than 700 head were killed and consumed, the sea-otter knows what man is. It has retired to the most inaccessible parts of the island. The companies place sentinels to watch during their sleep, and when warned by a shrill piping sound they all plunge at once into the sea, the immediate neighbourhood of which they now never quit. Only in very stormy nights, when the howling of the hurricane and the raging of the sea drown all other sounds, can they be surprised by cautiously creeping up against the wind.

At the present day, according to the account of H. W. Elliott, two-thirds of the sea-otter skins of commerce come from two small islands on the coasts of Alaska. The sea-otters land only on the most retired cliffs washed by surging waves. They no longer venture to the middle island, the only habitable one, they sleep on the water on tangle, and keep such strict watch that the hunters are compelled to expose themselves to the severest privations, to light no fire, never to smoke, to sleep in pits in the snow, in short to lead a life full of hardship and danger to get a few rare skins. The animal which in the time of Steller was the most careless and confiding of creatures, is now a model of wiliness and wariness. Is it possible to maintain that this animal has learned nothing? "The quick hearing and acute smell possessed by the sea-otter," says Elliott, "are not equalled by any other creatures in the Territory. They will take alarm and leave from the effects of a small fire four or five miles to the windward of them, and the footstep of man must be washed by the tide many times before its trace ceases to alarm the animal, and drive it from landing there should it approach for that purpose."

Sea-otters are shot with bullets through the head; they are surrounded by boats and transfixed with spears; they are felled with clubs during the terrible storms of these regions, where they hide on the shore amid heaps of tangle; they are even caught in nets. But the yield of this hunt is diminishing so much from year to year that the government of the United States has already taken measures to protect this valuable animal from complete extinction.

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE FLESH-EATERS.

The **geographical distribution** of the Carnivora presents many characteristic features.

Two regions, the Antilles and Australia, possess no native carnivores. Doubts may be raised as regards the latter, which at the time of its discovery by Europeans was inhabited by a species of wild dog, the dingo. But it is almost certain that this dog does not originally belong to Australia, but that it was brought thither by the first settlers, the ancestors of the Australian savages, and afterwards ran wild. As for the American islands, we are quite sure that no trace of a native carnivore has ever been found there. But this absence of carnivores in the two regions mentioned can excite no surprise, for with the exception of a few bats and rodents, probably imported, Australia has not a single placental mammal, and the Antilles have, in addition to a few immigrant representatives of the two orders just named, only the Solenodons, a special family of the Insectivora.

The large island of Madagascar is somewhat better supplied with representatives of this group. Besides the fossa (Cryptoprocta), that remarkable type whose affinities we have indicated above, Madagascar contains some peculiar genera (Galidia, Galidictis), which in all their characters belong to the **Viverrida**. Now this family, one of the oldest among the Carnivora, as we shall see in the sequel, inhabits all the warm regions of Africa and Asia, not excluding the Sunda Islands. It extends, indeed, to the countries bordering on the Mediterranean, and two species, the common genet and an ichneumon, belonging to the family, even cross the Straits of Gibraltar; but since the Viverrida are entirely confined to the Old World, their presence on the great African island can be understood.

The **Hyænas** also belong to the warm parts of the Old World, and more particularly to the African continent; yet the domain of the striped hyæna extends to India and there to the foot of the Himalayas, while the other two species as well as the aard-wolf (Proteles) are restricted to the mainland of Africa. Some have sought to explain the presence of the striped hyæna in Asia Minor, Persia, and India, as due to an immigration from Africa; but since fossil hyænas occur in the Miocene deposits of the Sewalik Hills, it is more probable that the present species is a direct descendant of these old forms, which has not changed its seat, but has rather extended its domain westwards by migrations in earlier geological periods.

Many of the **Small Bears** of Asia and America can be shown to be specially localized. The cacamizli, the raccoons, coatis, and kinkajous or honey-bears are exclusively American, while the binturong, the panda, and his large cousin the ailuropus inhabit only the high mountains of Tibet and the Himalayas.

The typical **Large** or **True Bears** inhabit the cold and temperate parts of both hemispheres. In the warm regions, on the other hand, are found more or less abnormal forms, such as the sloth-bear and the small climbing bears with a light-coloured neck-fillet. But the whole of Africa is without bears, and tropical America would be in the same condition were it not that the great chain of the Cordilleras possesses its spectacled bear, which approaches the other tropical forms.

The **Felida**, **Canida**, and **Mustelida** swarm in all regions inhabited by carnivores, with the exception of Madagascar, the Antilles, and Australia. It cannot even be said that many individual genera are peculiar to definite limited areas. If some, such as the cheetahs or hunting-leopards among the **Felida**, are confined to the warm regions of the Old World, yet the true cats, by which we mean the members of the genus Felis, and also the lynxes are distributed over both hemispheres from the extreme north to the tropics. It is the same with the **Canida**: dogs, wolves, and foxes are met with everywhere. In Africa alone can we point to the large-eared forms (Lycaon, Megalotis, Fennecus) as localized, while China and Japan possess the abnormal genus Nyctereutes. The **Martens** and **Weasels** are found everywhere. The glutton is a form peculiar to the Arctic regions of both hemispheres. The otters inhabit all countries containing carnivores of any kind; but the sea-otter is a special type belonging to the northern coasts of the Pacific Ocean as far as Behring's Strait. In the **Badger** family Ictonyx is essentially African, the genera Arctonyx, Mydaus, and Helictis are Asiatic; Mephitis and Taxidea are exclusively American. The true badgers, the genus Meles, are natives of the cold and temperate parts of the Eurasian continent, while the honey-badgers belong to the tropical parts of India and Africa.

Altogether we observe in the geographical distribution of the Carnivora, along with a marked tendency to a general distribution over the whole of the continental surface of the earth, some striking local restrictions and deficiencies, which can scarcely be explained as due to the external conditions of climate and food. Why could the Viverrida, which are so widely distributed in the tropical parts of the Old World, not live also in South America? Why could the bears not live in Africa? What is the significance of the absolute exclusion of the Carnivora from the Antilles, and of that of all families except the Viverrida, together with the fossa (Cryptoprocta) from Madagascar? Whence this wide distribution of the most important families over both hemispheres, over against the exclusion of the bears from Africa, and of the hyænas and Viverrida from America?

Palæontology can give no categorical answers to these questions, though it may, perhaps, throw some light upon them.

Two sets of facts become prominent in investigating the question of the **origin** of the Carnivora; on the one hand, the resemblance to carnivorous marsupials presented by several old genera, and, on the other hand, the equivocal nature of the characters, especially as regards the dentition, which, in the case of many of the older fossil remains, does not allow of us referring them to any of the families now living.

Among the old Carnivora palæontologists have distinguished one family, now extinct, which lasted on from the Eocene to the Pliocene, which was represented both in America and in the Old World, and whose dentition exhibits such singular characters that some authorities have ranked it among the marsupials. After the typical genus Hyænodon, which is represented in both hemispheres, this family, consisting of half a dozen genera, has been called the Hyænodontida. The form of the molars, among which there are always several carnassials, approaches that of the carnivorous marsupials, and judging from the casts of skulls that it has been possible to make, the brain also resembled the marsupial brain. The members of the family were yet without doubt true placental mammals. Filhol has been able to prove this by the study of the milk dentition, which is very different from that of the marsupials. In these latter there is, in fact, only a single tooth, the last premolar, which is replaced by a permanent one, while in the Hyænodontida, as in all true carnivores, the incisors, canines, and premolars are all deciduous, those of the milk dentition being destined to be replaced by a permanent set. But, notwithstanding this irrefragable proof of the right of the Hyænodontida to a place among the Monodelphia, the resemblance of their dentition to that of the marsupials still remains, and this fact seems to point to marsupials as the forms from which those extinct carnivores are to be derived.

The equivocalness of the characters of many of the primitive carnivores is an equally remarkable fact. The oldest known carnivore, the genus Arctocyon from the sandstone of La Fère, in the French department of Aisne, a formation belonging to the Lower Eocene, was of the size of a wolf, and had intermediate characters between the dogs and bears. Several Miocene genera (Amphicyon, Hyænarctos) present similar affinities. Amphicyon had a dentition so closely approaching that of the dogs that one may fall into some embarrassment in trying to distinguish these remains. "But Amphicyon," says Gaudry, "was a plantigrade and perhaps a climber like the bears, while the true dogs are digitigrade, and are not climbers. The upper canines of Amphicyon were much longer and straighter than in the dogs; the premolars and the carnassial were smaller, and, on the other hand, the surface occupied by the tubercled, that is, by the omnivorous teeth, was much larger in comparison with the extent of the incisors; these characters contribute to indicate relationships with the bears."

I will not enter further into these details. Let it suffice to say that in Europe, as in America, a number of these intermediate genera have been found; that in the Eocene there have been found connecting links between the Canida and Viverrida (Cynodon), between the Viverrida and the Felida (Limnofelis), and between the Mustelida and the Felida (Pseudælurus), and that in the Miocene have been found connecting links between the Viverrida and Hyænida (Ditítherium, Hyænictis), and between the Viverrida and the Mustelida (Lutrictis).

It is thus established, that none of the families now living is clearly represented in the Eocene strata; but that there we may find the stocks of the Canida, Ursida, Viverrida, Mustelida, and Felida more or less marked by subordinate relationships. On the other hand, almost all the important carnivorous families are clearly represented in the Miocene either by genera still living or by extinct genera. The only exception is the family of the bears, including both Large and Small Bears, remains of which have not yet been discovered lower down than the Pliocene. This fact may be regarded as all the more striking since the most prominent characters of the bear family, apart from the dentition, namely, the clumsy limbs and plantigrade feet, appear to have been common to all Eocene forms. But when we remember that the plantigrade Arctocyonida (Amphicyon, Hyænarctos, &c.) are still very abundant in the Miocene strata, that at this time they had a very wide geographical distribution both in the Old and the New World, we cannot resist the idea that the bears are the direct descendants of these families, of which they have retained the clumsy forms and the plantigrade mode of progression, while their dentition became gradually more and more adapted to an omnivorous diet.

The present families have inhabited the same great geographical regions from the time when they became fixed. The gigantic Machairodi roamed over both hemispheres in the same way as the present Felida now do, and were found there along with Canida and Mustelida. The Viverrida and Hyænida were then excluded from the New World, as the Procyonida were from the Old. All these varied modifications or differentiations, to use the technical term, have thus been effected independently in the two hemispheres, and have originated in separate mixed forms and intermediate stocks indigenous in each. These facts are another proof that the two great continental masses have been separate since the Eocene period. Not till Quaternary times, when the ice-masses had restored bridges for them, could the Polar bears become simultaneously distributed over both hemispheres. The similarity, and, in fact, almost complete identity, of so many species which are found, on the one hand, in the Hudson's Bay Territories and in Canada, on the other hand, in Siberia and Lapland, may be appealed to as a proof of this connection between the two hemispheres in the far north.

If these last facts stand firm and irrefutable, we possess, on the other hand, well-grounded indications of less distant relationships. During the Miocene period the hyænas were distributed over a wide area in Southern Europe; Sansans, Montpellier, Pikermi are sign-posts pointing to Asia, where the Sewalik Hills at the foot of the Himalayas form the boundary-mark on the east. The cave-hyæna (*Hyæna spelæa*) inhabited in Quaternary times retreats in France, Germany, Belgium, and even in England, which was then connected with the Continent. But this cave-hyæna presents so much resemblance to the still living spotted hyæna (*H. crocuta*) that the latter might well be regarded as its direct descendant, and, on the other hand, as Gaudry has shown, possesses such close affinities to a species found in the Pliocene deposits of Perrier in Auvergne (*H. perrieri*) that this may be looked upon as its immediate ancestor. The striped hyæna of the present day is distinguished only by insignificant details from another species likewise found at Perrier (*H. arvernensis*). The brown hyæna may be regarded as the direct descendant of a species found at Pikermi (*H. eximia*). The origin of the three species of hyæna now living is accordingly pretty plainly demonstrated.

The study of the milk dentition is of the utmost importance in investigations of this sort. The milk dentition, as we have already said, is the family treasure which preserves the characters by means of which the front teeth, including the premolars, were marked in the ancestral forms. The true molars are afterwards added to the milk dentition; but they also existed in the ancestor, and for the most part, indeed, in considerable number. Now we have seen that no carnivore now living has more than one carnassial in each half of each jaw, and this tooth, so highly characteristic of the order, is always the last premolar in the upper jaw, and the first molar of the permanent dentition in the lower. In all genera which have well-developed carnassials these exist, even in the milk dentition; but then it is always the second last premolar in the upper jaw and the last in the lower which exhibit this characteristic form. The carnassial accordingly moves further back at the shedding of the teeth. This is particularly obvious in the hyænas, in which the carnassial of the milk dentition is replaced by a thick conical tooth in the permanent one. From these facts it may, in my opinion, be inferred that the ancestors of these carnivores must have possessed two more or less developed carnassials, the first of which has been lost in the permanent dentition which now characterizes their descendants. Two such carnassials, more or less fully developed, are found, on the one hand, in many of the marsupials of the present day, as, for example, in the Tasmanian devil (Dasyurus), and, on the other hand, in many extinct types, like Hyænodon, Pterodon, Cynodon, &c. We may accordingly assume that these old types are connected with the carnivores of the present day by direct generation.

We have thus summed up the facts. They show, as it appears to us, that the primitive stocks of the Carnivora must be sought in the Marsupialia, which existed long before the Tertiary period, and that these stocks were from the first numerous. It is highly probable that certain families are directly descended from marsupial ancestors. The Viverrida are beyond question in this position. Their dentition approaches so closely that of the insectivorous and carnivorous mammals, that we might often be in doubt where to place an animal of which only the dentition was known. Other families, such as the dogs and bears, appear to be derived from the intermediate forms already mentioned. But all these generations were so clearly separated from one another in both hemispheres by the end of the Eocene period, that certain families could not develop at all in one of the two, while others were enabled to reach the highest stage of their development. The Hyænida and Viverrida have not been able to develop in the New World nor the Procyonida in the Old, because the intermediate forms from which these families might have proceeded have been wanting since the origin of the placental mammals. The Canida, Felida, and Mustelida, on the contrary, have had fruitful branches in both hemispheres. In this manner is explained, at least in part, the present geographical distribution with respect to the land-masses which were already isolated in early geological periods.

If this separation already existed during the Tertiary period it does not follow that migrations in the interior of these land-masses could not take place, and that changes in climate which occurred in the course of the geological epochs should not have had a great influence on the present distribution of the Carnivora. In consequence of these changes the hyænas, which still inhabited Europe in diluvial times, have since left it, and the gluttons, which once advanced further to the south, have subsequently again retired. There is no doubt that many Felida, Canida, Mustelida, and Viverrida, thanks to their fleetness and energy, have been able to spread themselves during geological periods over wide stretches of territory, while other more clumsy types remained pretty much confined to the limits within which they are still found.

THE SEALS

(PINNIPEDIA).

Aquatic carnivores with feet converted into flippers, spindle shaped body, complete dentition, and zonary placenta.

The **Flipper-footed** animals, or Seals, as they are usually called, are carnivores adapted to an aquatic mode of life. They show, in fact, in all the features of their structure, with the exception of the characters necessarily following from this adaptation, a real affinity to the true Carnivora, with which many authors have united them as a sub-order. They are, in relation to the Carnivora, what the Chiroptera are to the Insectivora—a transformation of the general type with reference to a quite specialized mode of life.

The head is small, the muzzle seldom prolonged, usually blunt, and the mouth surrounded by very thick fleshy lips, on which are set strong, stiff, and mostly spirally twisted whiskers. The nostrils are in the form of narrow slits at the point of the snout; and the cartilages by which they are surrounded are so constructed that they close the openings by their elasticity, while they can be expanded by means of strong counteracting muscles. These slits lead into wide nasal cavities with labyrinthine olfactory chambers, which are not less highly developed than in the dogs, and, accordingly, bear witness to a very keen scent. The large expressive and beautifully coloured eyes are highly convex in front, and are protected by broad eyelids with very long lashes. The skull proper is round and broad, but the ridges by which that of the land carnivores are marked are slightly developed except in the eared seals (Otarida). The outer ears are either entirely absent or are only indicated by the weak and very slightly projecting margins of the ear-flaps. The mouths of the ear-passages can be closed like the nostrils when the animals dive. The neck is generally short, but well marked off from the head. The form of the body is that of a spindle, thick in front but thinning towards the posterior extremity. The body ends in a short flattened tail almost hidden by the hind-flippers, which are always directed backwards in an almost vertical position, and form along with the tail a powerful swimming apparatus.

The limbs, although formed on the general plan, yet exhibit marked peculiarities. The bones of the fore-limb, with the exception of those of the digits, are very short, twisted and flattened, and in the ordinary seals are almost wholly concealed by the strong muscles that move them in the mass of the body. The flippers show in the skeleton, indeed, the five quite separate and pretty long digits, but in the living animal they are united by strong ligaments down to the last phalanges, which are usually armed with not very sharp claws. The hind-limbs are attached to a strong pelvis well fastened to the end of the vertebral column; but this whole region is likewise mostly hidden in the flesh. The digits of these limbs are long, but connected to form oars like those of the fore-limbs. The skin always projects beyond the nails, which appear to be set on the back of the flippers and are sometimes altogether wanting.

The direction of the limbs is specially noteworthy. The fore-limbs are directed obliquely downwards. The palm of the hand is turned in the direction of the axis of the body. These limbs, in the ordinary seals especially, show the position originally assumed by the limbs in the embryos of all vertebrates, as long as they retain the form of fin-like lobes. The hind-limbs are directed so far backwards that they continue the horizontal direction of the vertebral column; and the sole of the foot is turned towards the vertical median plane of the body, the first digit forming the inferior edge of the member. This arrangement of the limbs, altogether embryonic in its character, is retained more particularly in the common seals. In the eared seals the limbs are more slender, and the fore and hind paws or flippers assume a somewhat different direction, which seems to aim at placing the soles on the horizontal plane of the ground.

The dentition is distinguished from that of the Carnivora by a greater variability in the number of the incisors, and by a less degree of specialization in the molars. The normal number of incisors in the Carnivora, six above and six below, is seen only in many of the young animals; but in most cases this number gets considerably reduced in the adult, and often so much so that the incisors are entirely absent. The outer incisor of the upper jaw often resembles the canine in form, but always remains smaller. The canines, which are always present, attain an enormous size in the upper jaw of the walrus, and are very strong in the eared seals. With respect to form there is no longer any difference among the teeth that come after the canines. They always stand apart from one another, and neither premolars nor molars, carnassials nor tubercled teeth can be distinguished. The first of these uniform molars is usually smaller and has a less pronounced form than the others. Often it has only a single root, while the others have two; but there end the differences that can be pointed out in seals' molars. But as regards the form which they present in different animals there are pretty considerable variations. In general the crowns are flattened on the sides and divided into several lobes, of which the middle one is most prominent, while those at each side often form sharp-pointed cusps. In other cases the teeth are more rounded, and in that way form a transition to the perfectly flat molars of the walrus. But even in these examples of retrograde development of the carnivorous dentition the lower jaw always shows an essential carnivore character in the structure of the joint by which it is attached to the skull—a joint in the form of a transverse semicylinder.

The body is mostly covered with a very short thick downy fur, in which are set short bristly hairs which never become wet.

Among the features of the internal organization we would draw attention to the large broad brain with numerous convolutions, as well as to special modifications in the structure of the vessels and the heart, by means of which these animals are enabled to remain for a long time under water without breathing. The placenta is zonary as in the land carnivores. The teats are situated very far back in the abdomen.

The seals are remarkably social animals, which live in all seas (sometimes in large flocks), which can ascend pretty high up rivers, and are even found in some basins now cut off from the ocean, such as the Caspian Sea, Lake Baikal, and the Sea of Aral. They are unquestionably very intelligent animals, devoted to their comrades, their consorts, and their young, animals which are prevented only by their form and their helplessness on land from becoming as attached and obedient domestic animals as dogs. Their movements in the water are very graceful and charming. They play with the fish they catch as cats do with mice, make wonderful leaps and long dives, swim under the water with marvellous rapidity, and in the liquid element show as much suppleness and agility as they display clumsiness and helplessness on land. They are nevertheless very fond of landing on coasts and banks of ice in order to bask in the sun, to rest, to caress each other, and the females to suckle their young. But the eared seals alone, thanks to their more flexible limbs, are able to traverse considerable distances on land, and even to climb pretty steep rocks. The ordinary seals move on land only with difficulty by fixing themselves with their flippers in front, and pulling up their hinder parts, then drawing their bodies up into a curve and throwing their front parts again forwards. They drag their belly along the earth, show little suppleness and soon become tired. This greatly facilitates the pursuit of these animals, which are chiefly hunted in the Arctic seas.

The Eskimo carry on this pursuit on a small scale in their slim kayaks, throwing a harpoon at a single seal to which is attached by a cord a bladder filled with air to mark the spot where the animal dived after being struck, and other nations carry it on on a large scale in order to appropriate the skins and the fat, with which the body is in a certain measure enveloped. The polar seals always keep in the neighbourhood of ice-fields, on the surface of which they are fond of basking in the sun, or assemble on certain coasts, especially rocky coasts. The vessels set sail in the beginning of spring, and on reaching the parts frequented by the seals the crew, armed with iron-pointed staves, land and try to cut off the retreat of the seals to the sea. The animals are stunned by blows on the snout, and afterwards killed by a stab through the heart. As soon as the ice melts the seals migrate polewards. I was able to observe these migrations during my visit to Jan Mayen. There about 10,000 seals are killed on an average every year, and there always remain many survivors, since the island is mostly begirt by ice the whole year round. On the occasion of our visit in August, 1861, however, the island was quite free of ice, and with it the seals had vanished. In the course of five days we saw only two specimens of the Greenland seal, which approached our ship with great curiosity, and one of which we succeeded in killing with a bullet through the head. To the Eskimo the seal is the basis of existence. They feed on its black flesh, which is at once tough and dry, because all the fat collects under the skin; they drink the oil obtained from the blubber by boiling, and this oil likewise furnishes them with the means of securing light and heat. They clothe themselves in its skin, whose rather short but warm fur is impervious to water, and the entrails when suitably prepared afford them water-tight coverings, skins for sausages, bladders, and even yarn, while the small bones of the limbs and tail serve as playthings for their children.

In this order, not very varied as regards its forms, but world-wide in its distribution and very rich in individuals, we distinguish three families: the **Eared Seals**, with visible external ears; the **True Seals**, without external ears; and the **Walruses**, with a very peculiar dentition.

THE EARED SEALS

(OTARIDA).

Easily distinguished by the character just mentioned, the visible external ears.

The external ears have the form of a semicircular flap, opposite which there often stands a small movable lobe. The head and the neck are longer than in the true seals, and the limbs being more free from the body can be used in walking. The webs on the feet project considerably beyond the ends of the digits, and are further extended by membranous lobes corresponding to the fingers; so that the small nails are situated on the upper surface of the flippers pretty far from the margin. The forearms and the legs are free, and by bending the longish paws at the wrist or ankle-joint the animals can raise themselves wholly above the ground and walk in that posture without trailing their bellies. They wind about in clambering up an incline, and in our zoological gardens they may be seen springing up a short flight of steps one by one pretty quickly, in order to reach a platform from which they have to plunge into the tank to catch a fish thrown to them. The voice of the large species is like the lowing of oxen.

The eared seals are certainly the most closely allied to the land Carnivora of all the Pinnipedia. The skull, furnished with a strong longitudinal ridge, and separated from the pretty long facial region by a narrow constriction, the large temporal fossæ surrounded by very wide zygomatic arches, the narrow palate hollowed out almost in the form of a channel, the large thick-rooted canines, the whole arrangement of the lines give to the skull of a sea-lion much resemblance to that of a bear. True it is that this resemblance disappears on a closer examination of the dentition in particular, but the general impression betrays the affinity.

The eared seals have six incisors in the upper jaw, three in each half of the premaxilla, but the outer pair are very strongly curved, and altogether show much resemblance in form to the very prominent canines. The molars, five or six in number in each half of the jaw, are all very like one another, in some cases provided with sharp-pointed cusps, in others with small sharp eminences at the base of the crown. These molars are set wide apart, and are almost of equal size. In the lower jaw there are only four not very broad incisors, very highly curved canines, and five isolated molars of similar form and equal size, on the crowns of which the small secondary cusps are usually better developed than in the upper jaw.

Dental formula: $\frac{3 \cdot 1 \cdot 5 \text{ or } 6}{2 \cdot 1 \cdot \quad 5} = 34\text{–}36$ teeth in all.

On the northern hemisphere the eared seals are absolutely confined to the Pacific Ocean and the surrounding seas, but on the southern they are found in all the polar parts of the Great Ocean, and ascend to the Cape of Good Hope as well as to America and Australia. A savage war is waged against them in Tierra del Fuego, on the Falkland Islands, and Kerguelen Land on the one hand, and on the coasts of California, Alaska, and Kamchatka on the other. We have selected for illustration two species belonging to the northern hemisphere, which play an important part in the fisheries of the last-mentioned coasts. Even in last century, in the time of Steller, the inhabitants of these inhospitable regions had committed such massacres among these animals on the islands of Pribylov, their chief resort, that the Russian government soon found itself compelled to regulate the fishery by strict measures so as to prevent their entire extirpation. Some idea may be formed of the destruction wrought by these senseless massacres when we are told that during the summer of 1868, when the islands with the territory of Alaska had just been ceded to the United States and the new government had not had opportunity to issue a new ordinance, the number slain reached the enormous total of 250,000.

At this time the number of eared seals assembled on the two islands of Pribylov, St. Paul and St. George, was estimated at three millions and a quarter. At present the company which has the monopoly has only the right of killing 100,000 head every year, and on some points of the coasts the rocks frequented by these animals have been laid under ban so that the seals may resort there in perfect security.

UNIVERSITY
OF
CALIFORNIA

Steller's Sea-lion (*Otaria Stelleri*), fig. 125, which is found on all the coasts of the Pacific Ocean from the north to California in the east and Japan in the west, but is especially abundant in the north on the shores of Behring's Strait, derives the name of sea-lion from an allied species (*Otaria jubata*), which in the time of Steller was very abundant on Tierra del Fuego and the Falkland Islands, and in which the male carries a small mane on the back of the neck. Our species, first described by Steller, has not this mane. It is the one that now delights the visitors to the *Jardin d'Acclimatisation* at Paris and several other zoological gardens. In the London zoological gardens there was once an old male of this species which had been wonderfully trained by a French sailor named Lecomte, and was just as intelligent and as much attached to its master as a dog. It is this species also which is protected near San Francisco, where it has settled on some rocks in the neighbourhood of a tavern called Cliff House, and is frequently visited by the inhabitants of the Californian city.

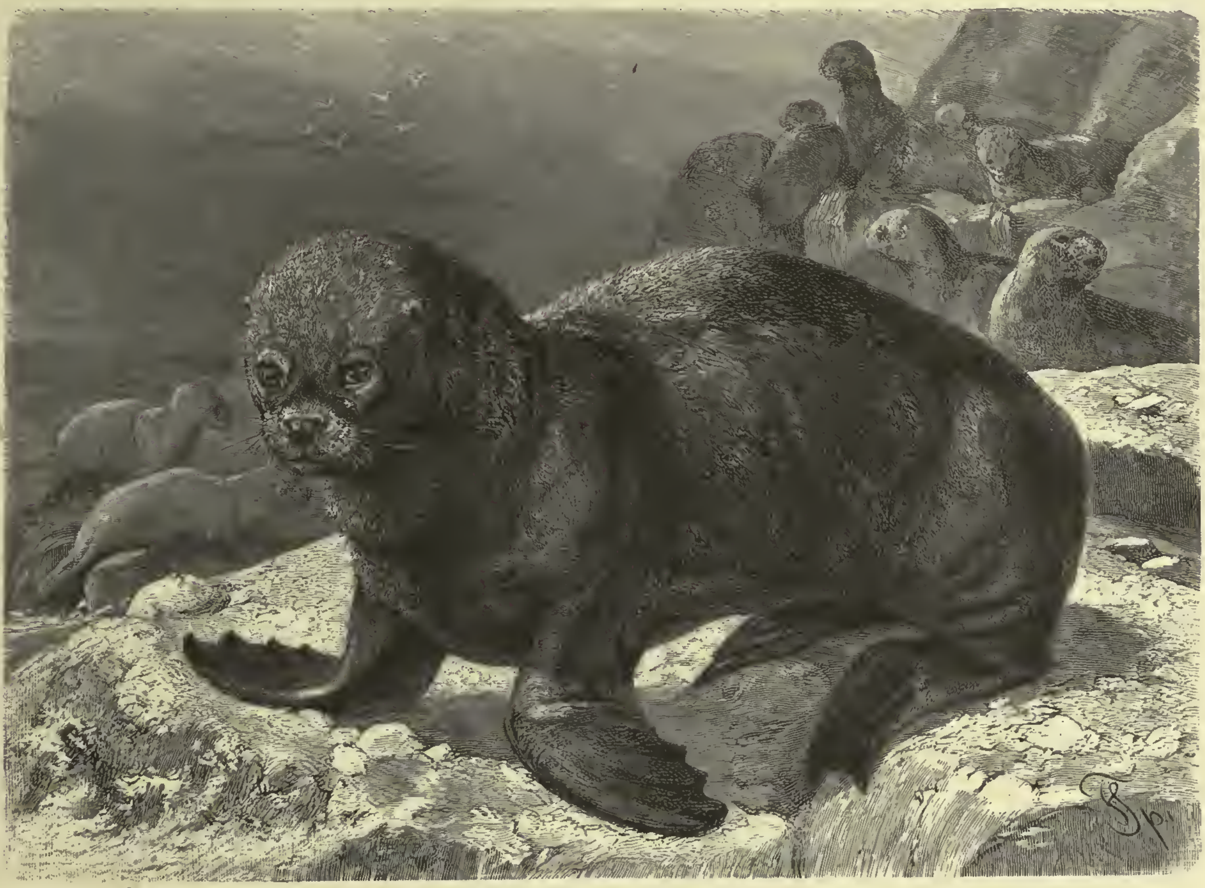


Fig. 125.—Steller's Sea-lion (*Otaria Stelleri*).

The adult male attains a length of 16 feet, and a weight of upwards of 1000 pounds. The head is pretty long, the ear is drawn out to a point below, and is covered with small delicate hairs. The eyes are large, prominent, and expressive; the swollen lips set with thick whitish whiskers, which grow to the length of 16 inches. The neck is long, but loaded with fat, forming great folds which fall down on the shoulders, and at a distance may easily be mistaken for a mane. The body is pretty long; the flippers of medium size, covered with a rough tubercled skin; the fur of a greenish colour with a golden shimmer, but pretty variable. It is composed of short rough hair without down. The females scarcely attain half the length and a fifth part of the weight of the males.

These sea-lions inhabit various coasts the whole year round, but they assemble, especially at the breeding season, on favourite spots. About 20,000 of them can be counted on St. Paul, and 7000 on St. George. The fisheries are pursued on the former of these islands. The old males, called by the sailors "beach-masters," arrive first, choose out a camping-ground, and await the arrival of the pregnant females, now near the period of delivery. When the females arrive the males go to meet them, seize them by the nape of the neck with their teeth and drag them to the camping-ground which they have conquered for themselves, and which they often maintain by terrible battles. After the birth of the young copulation takes place, and for a month at least the jealous male takes no food and keeps the six or eight females that he has selected constantly round him.

These animals are hunted for their fur, which is used to cover light skiffs and furniture, and for their fat and their entrails, from which last cords and water-tight blouses are made. About 800 are killed on St. Paul every year. They are very wild and shy, and plunge into the water on the slightest appearance of danger. Their pursuers endeavour to cut off their retreat by landing on a stormy night when the wind is blowing from the land, and then chase them in troops to the village fifteen miles off. The animals walk clumsily and laboriously with winding movements of the body, first raising the front part of the body, then plunging forward, and in a sense diving in order to advance. If from utter exhaustion they will go no further their pursuers are in the habit of frightening them by the sudden opening out of an umbrella. In this way the journey is accomplished in five or six days, and the animals are then killed by musket-shots through the neck or by stabs with spears through the heart.

The **Sea-bear** (*Otaria ursina*), fig. 126, is a much more important object of pursuit, for about 90,000 of them are annually killed on the island of St. Paul and 10,000 on St. George. This seal is much smaller than the sea-lion. The males attain the length of only 10 feet, and the females half that length. The neck is short, the flippers pretty long, and covered with a short black skin. The fur, of a dark brown colour, soft, very thick, and as glossy as silk, with a few stronger hairs interspersed through it on the breast, is a very valuable article of commerce. Thanks to the length of their flippers, these animals can walk on the ground with regular steps and with the whole of their body raised.

The first males arrive on St. Paul in the beginning of May. It is not known where they pass the winter; it is very likely that they migrate southwards. These males choose their camping-grounds on well-known breeding places, and defend them obstinately against the swarms that follow after. When all the spots on the edge of the sea are occupied by the "beach-masters," the later arrivals, and among these old males known as "reserves," must content themselves with camping-grounds further back, and the "bachelors," at most five years old, are compelled to retire to the surrounding islands, whence they look out for a favourable moment to seize upon a place or even a female deserted by a beach-master. But the old males do not stir from the spot except when they go to meet a female, and the attempts at occupation lead to furious encounters.

At last, about the middle of June, all the males are assembled and encamped awaiting the arrival of the females. The bulls go to meet them, seize them with their teeth, and drag them to their camping-grounds. But other females arrive, and since at least seven or eight are required to make up the harem of an old male, the latter must leave his first conquest to go and make a second. Meanwhile a neighbour, a reserve or a bachelor, robs him of his first. Fierce battles ensue, murderous encounters in which blood flows down in streams, and one of the antagonists is often killed. At the end of this period not a male remains which is not covered with wounds, scars, and putrefying sores. But then there are heroes who possess as many as forty wives!

Immediately after their arrival the females give birth to a single young one, and within a few days after the birth there are new fights, since the females are not insensible to the solicitations of the bachelors. At last the females give themselves up to the tender care of their young, which they suckle on the land, and at the end of six or seven weeks dive into the sea to teach them to swim. At first the young are so inexpert in swimming that they are often in danger of drowning.

During this period, which lasts in all, perhaps, three months, the beach-masters, which had arrived large and fat at the beginning of the season, have remained, as Trouessart states, without meat or drink, bound day and night to their camping-grounds, fighting and watching without intermission. They are now reduced to skeletons, and scarcely have strength enough to drag themselves into the sea. At last at the beginning of October all is ended. The shore is deserted. The old ones have gone off first, and the others have followed them.

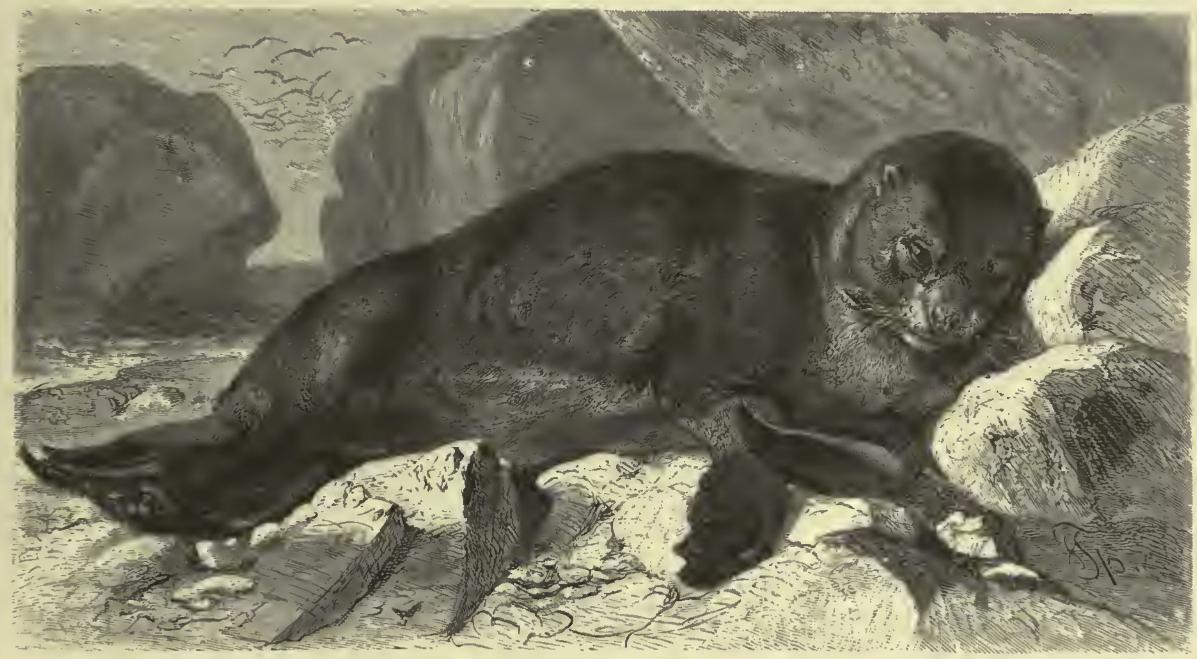


Fig. 126.—The Sea-bear (*Otaria ursina*).

The destruction of these animals by the seal-fishers is facilitated by the order which the sea-bears observe in their encampments. They are killed chiefly for their skins, which, after undergoing a careful and laborious treatment, are sold in England as linings for garments. At the place of capture they are merely salted. Only the three-year-old bachelors, which yield the finest furs, are slain. Since these lie apart from the others the old males with their harems are not molested, and get so accustomed to the presence of man that one can move about in these singular encampments without disturbing them. As for the bachelors, they are surrounded during their sleep, their retreat to the sea cut off, and then they are driven in hundreds to the slaughtering places, which lie at a distance of a mile and a half at most. There they are struck down with clubs, their skin stripped off and salted, and the oil, which is used only by the natives, since its smell is very strong, extracted from their bodies by boiling. The very tough and ill-smelling flesh is eaten only by the inhabitants of the Aleutian Islands.

THE TRUE SEALS

(PHOCIDA).

Distinguished from the eared seals by the absence of an external ear

Besides the distinguishing mark just mentioned there are several other characteristic features in the members of this group. Among these are short limbs, the upper part of which is buried in the flesh of the body, while both sides of the flippers are covered with hair; the two outer toes of the hind-limbs longer than the inner ones; and the negative character consisting in the absence of lobes on the flippers, continued beyond the end of the limb in the direction of the digits. The dentition varies in different genera as regards the number of the incisors and the form of the molars, which often have only one root. On the strength of these characters several genera have been distinguished.

All these animals have at bottom the same habits, differing only in accordance with the climate of their resorts and the more or less injurious acquaintance which they have made with man, who often pursues them with fury for their skins, their fat, and in northern lands also for their flesh. They always live gregariously and often in very numerous flocks, near the coast or near ice-fields, and readily quit the water to rest, to sleep, or to bask in the sun. Mostly of a peaceable and yielding disposition they get into conflict with one another only at the breeding season, when similar scenes take place to those which have been described with reference to the eared seals. They sleep at irregular hours, and seek their food, which consists of fish, crustaceans, and molluscs, according to the hours and seasons. They swim and dive admirably, sleep swimming, and perform the most astonishing feats in swimming with ease and elegance. The shortness of their flippers renders them very awkward on land, but they take advantage of the flexibility of their spinal column in order to drag themselves up steep rocks. Curious and intelligent (for curiosity is always the mother of intelligence) they are often attracted by objects which they have never seen before. In those parts where they have not yet made acquaintance with man they come up and examine with interest ships, boats, and men who have landed on the beach, and exhibit much gentleness and a complete confidence, which is often their destruction. They love and protect their offspring, and female seals have been seen to weep over the loss of their young. In the case of many species it has also been shown that they come to the assistance of comrades in danger. Sharks, large dolphins, and in the Arctic Regions the polar bear are their greatest enemies next to man; but in many parts of the world they are masters, and live in a peaceable and comfortable manner.

The scene is changed as soon as man appears to hunt them. Endowed with sharp sight, keen scent, and sufficiently good hearing, the seals very soon learn to withdraw themselves from attack so far as possible. They become timid, approach the shore only with extraordinary caution, raise their nostrils above the water to breathe only for an instant, examine the district carefully before they come to land, and appoint sentinels during the period of rest. After a few years they begin to know the range of firearms, and the hunters must then employ all the devices employed in fox-hunting to outwit them. Unfortunately the period of learning was too short for some species, and has scarcely sufficed to prevent their complete extermination.

The young seals swim immediately after birth, without having to undergo the training necessary in the case of the sea-lions.

The **Sea-elephant** (*Cystophora proboscidea*), fig. 127, is the largest of the Pinnipedia, attaining a length of 26 feet, and a weight of more than 5 tons. It belongs with the next species to a genus distinguished by having canines with enormous roots and short thick crowns like those of bears. There are further five small molars, standing apart from one another, almost round in shape, and provided with a few confluent folds and a single root, and only two small close-set incisors in the lower jaw, while in the upper jaw there are four, the two outer ones being canines in miniature. Dental formula: $\frac{2 \cdot 1 \cdot 5}{1 \cdot 1 \cdot 5} = 30$ teeth.

These animals live chiefly on crustaceans and molluscs.

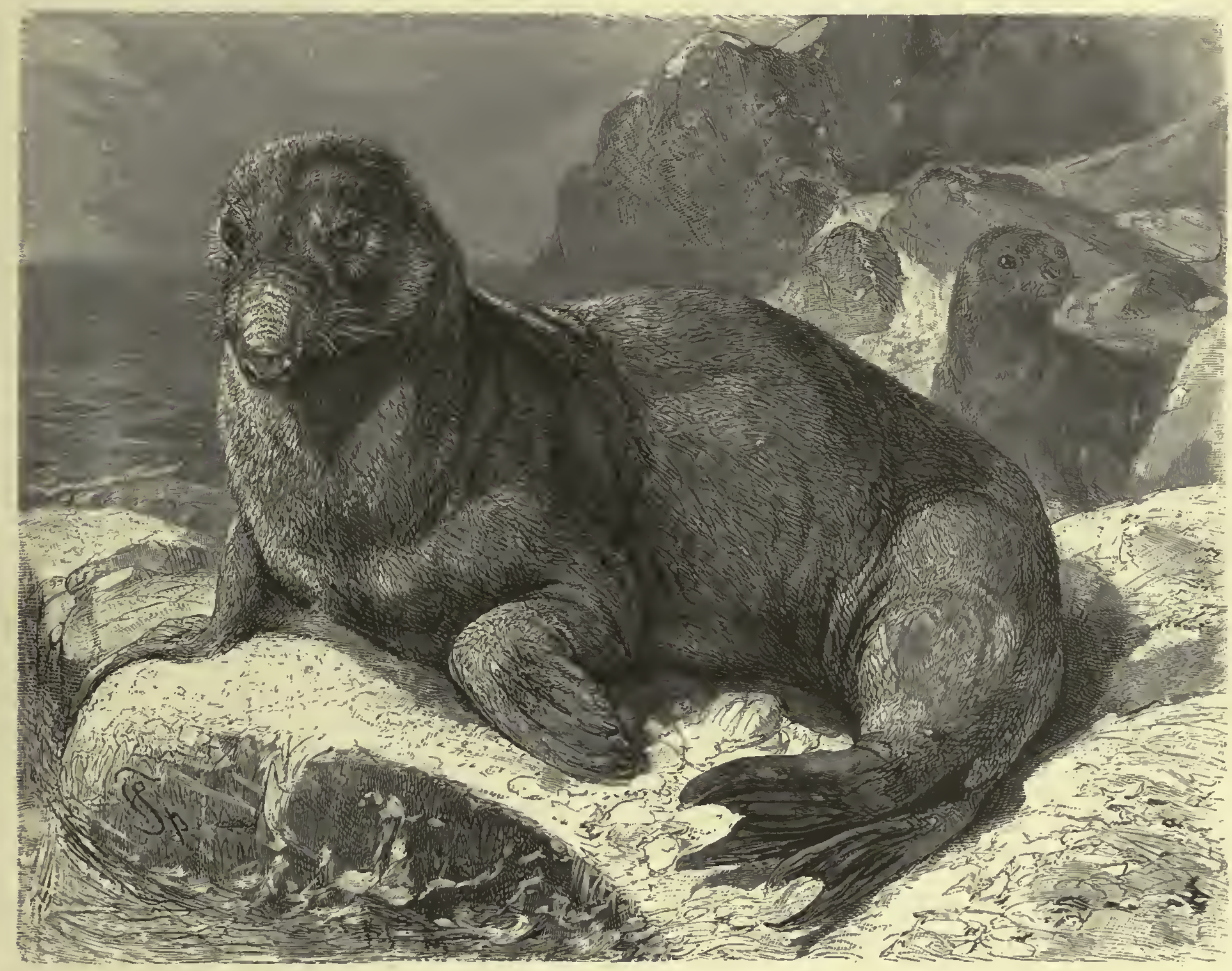


Fig. 127.—The Sea-elephant (*Cystophora proboscidea*).

The sea-elephant inhabits the Antarctic seas, and formerly came in numerous flocks to Patagonia, California, and Tasmania, while at the present day only isolated individuals are met with on the coasts of California, and the others have retired to the almost inaccessible rocks of the Antarctic Ocean. The head is broad and round, the eyes are surrounded by only a few tactile hairs set in concentric circles. On the lips there are scarcely any such hairs. The front-flippers are short, and the digits are furnished with short strong claws, while those of the hind-flippers are without either nails or claws. The male has a short proboscis marked with transverse folds, and the nostrils open on the lower surface at the end of this proboscis, which hangs down over the mouth when the animal is resting. The sea-elephant can blow up its proboscis so as to resemble a thick sausage. The female, which is much smaller than the male, shows no trace of this ornament. The uniformly coloured fur is bluish-gray or brownish; the hairs are short and stiff.

The habits of this species resemble those of the sea-bears. The creatures are very helpless and clumsy on land, and appear to be in general very indolent and extremely good-natured, so that one could commit the most unreasonable massacres among them with impunity.

The genus is represented in the Greenland waters by the **Bladder-nosed Seal** (*Cystophora cristata*), fig. 128, which attains the length of only 10 feet, and in which the proboscis of the male is replaced by a pretty broad sack divided in the middle, lying on the surface between the brow and the nose, and capable of being blown up in such a manner as to resemble a thick cap sitting on the creature's nose.

In the hind-flippers the two outer digits are pretty long, and they alone are provided with claws, the inner ones being nailless. The rough, coarse fur has a ground-colour of gray, over which are scattered on the sides a number of broad, almost black indistinct patches.

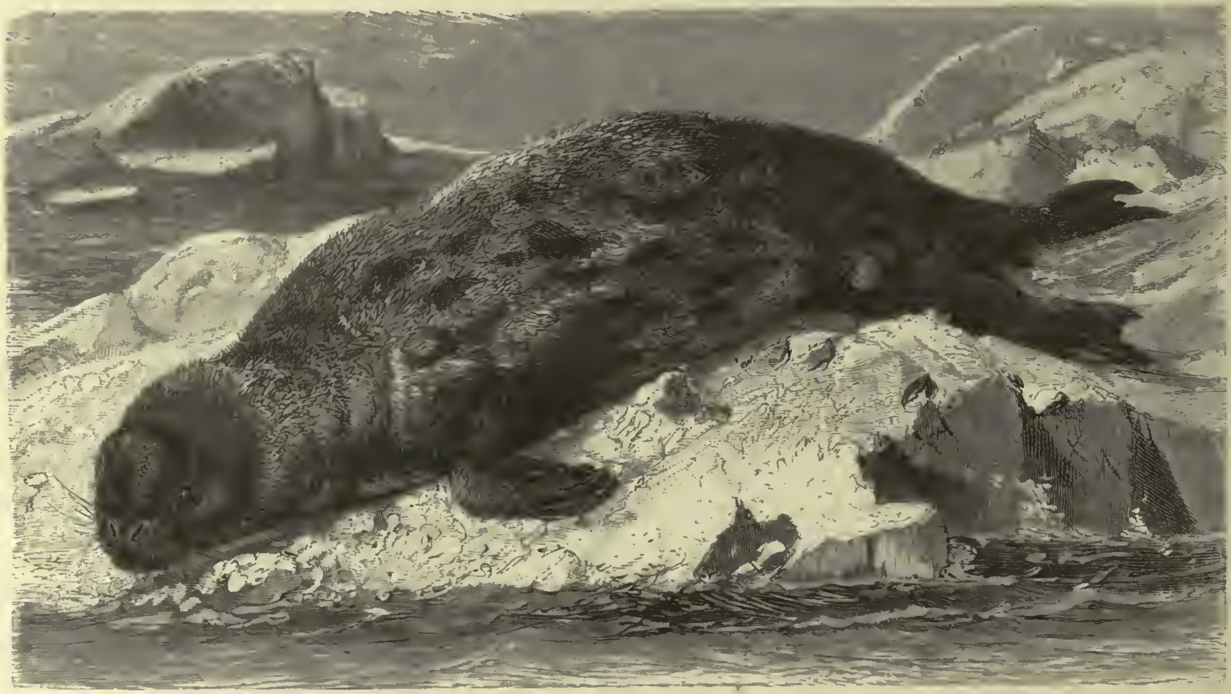


Fig. 128.—The Bladder-nosed Seal (*Cystophora cristata*).

This seal inhabits principally the ice-fields, is very passionate and courageous, and attacks the hunter, bellowing like a bull. The Eskimo scarcely venture to pursue it in the water, where it dashes against their kayaks and tries to shatter them with its teeth. On the ice they attack it with spears.

"With the exception of the bladder-nose, the seals in the Greenland Seas appear to have little or no combativeness in their nature, but are a harmless, persecuted, sportive race of graceful athletes, making merry the solitary waters of polar lands.

"On the other hand, the male bladder-nose is, in truth, the lion of the sea, dividing the empire of the polar waters with its huge ally the walrus. Instead of flying at the approach of the hunter, he will quite calmly await the approach of danger, preparing for defence by betaking himself to the centre of the piece of ice he is on, and blowing up the air-bladder on his forehead while he rears his head and sniffs the air like an enraged bull, and often gives battle successfully, making the clubs fly from the hands of his assailants with his flippers, his head being protected as with a helmet by the air-bladder. He will then in turn act on the offensive, and put his opponents to flight, pursuing them with a shuffling serpent-like motion over the ice, the result often proving dangerous to the panic-stricken hunter if the boat has left that piece of ice, as the seal will use his tusks rather ferociously when thus enraged. However, he is not inclined to give battle unless provoked, and looks a dull, stupid-looking sort of epicurean as he lolls on the surface of the ice and gazes about with his large black eyes in an apparently meaningless stare."—Dr. R. Brown on the Seals of Greenland in the *Manual of Instructions for the Arctic Expedition*, edited by Rupert Jones, 1875.

The southern seas, including the Mediterranean, are inhabited by seals which have two incisors in each half of the jaw both above and below, small canines, and molars with pointed lateral cusps besides the sharp middle one. Of these teeth the first has only one root, while the others have two. These seals form the genus Leptonyx. Dental formula: $\frac{2 \cdot 1 \cdot 5}{2 \cdot 1 \cdot 5} = 32$ teeth.

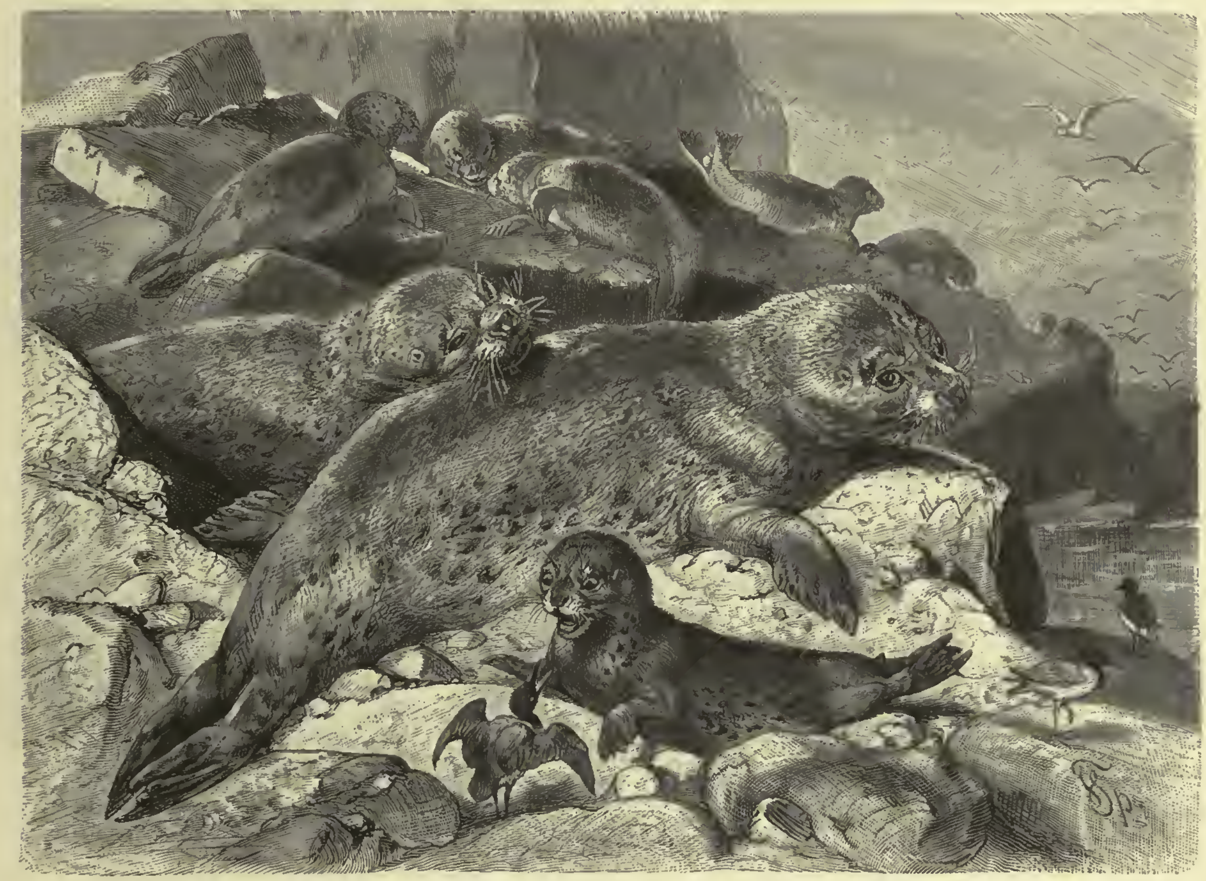


Fig. 129.—The Sea-leopard (*Leptonyx leopardinus*).

As representative of this genus, which includes also the **Monk-seal** of the Mediterranean (*Leptonyx monachus* (*Monachus albiventer*)), an illustration is given of the sea-leopard (*Leptonyx leopardinus*), fig. 129, of the Antarctic Seas, which attains the length of about 12 feet, and has a gray-brown fur interspersed in places with bright yellow spots. The nails are small but sharp, their colour black. On the hind-flippers they disappear with age. The skull is longish, the fur short, thick, without down.

The true seals, in the most restricted sense of that term, the animals forming the genus Phoca, have three incisors above, like the land Carnivora, but only two below. Dental formula: $\frac{3 \cdot 1 \cdot 5}{2 \cdot 1 \cdot 5} = 34$ teeth.

The molars are deeply notched and very sharp. A somewhat different genus (Halichœrus) has conical molars without lateral lobes.

As representative of this group composed of the ordinary seals of our coasts, found only in the northern hemisphere, the group to which among others the **Common Seal** or Sea-calf (*Phoca vitulina* of Linnæus) belongs, the **Greenland Seal** (*Phoca grœnlandica*), fig. 130, has been selected for illustration. It is the commonest species in the northern seas, and its pursuit is carried on chiefly by the

Eskimo and the Europeans. The animal attains a length of only 6½ feet at most. In early years it is of a uniform gray colour, somewhat darker on the back. Gradually the dark colour increases, and in adult animals it forms on the back two large patches resembling a saddle. The second digit of the fore-flipper is longer than the others. Ice-fields are the favourite resort of this species.

The species of the Caspian Sea, the Sea of Aral, and Lake Baikal all belong to this group.

THE WALRUS OR MORSE

(TRICHECHUS ROSMARUS—PL. XV.).

This enormous creature, which attains a length of from 20 to 23 feet and a weight of 3300 lbs., forms a family by itself. It inhabits the ice-covered waters of the Arctic Ocean. The thick and unshapely body is very massive behind, the neck relatively thin, the head small. The tail is rudimentary, the thick lips set with stiff whiskers, each hair of the thickness of a raven's quill. The nostrils are situated on the highest part of the blunt muzzle. The eyes are small. The thick loose skin has a smooth covering of bristly hair, which in the young animal is brown, in adults yellowish, and in old animals is disfigured by numerous scars and naked patches. The end of the snout and the soles of the feet are naked.

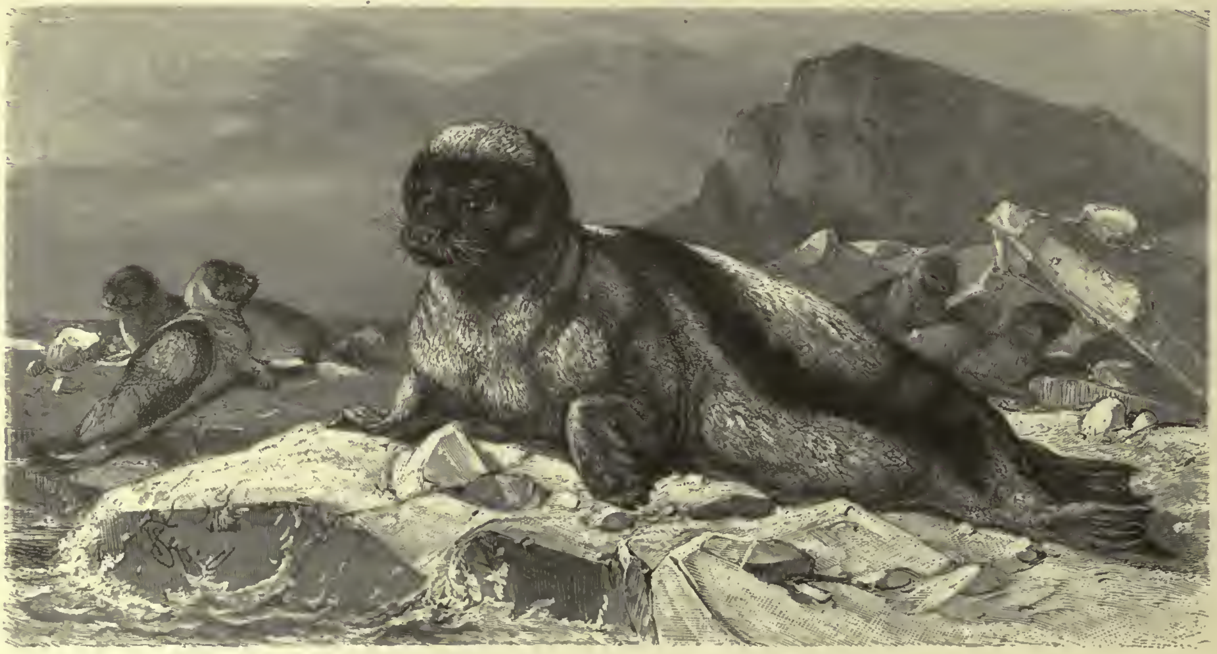


Fig. 130.—The Greenland Seal (*Phoca grœnlandica*). page 249.

The dentition is different from that of all other seals. In the upper jaw are to be seen two straight massive tusks, obliquely cut away on the outer surface. These project far beyond the lips and may attain a length of 2 feet and a weight of 17 or 18 lbs. The incisors are altogether wanting, both in the upper and lower jaw. The flat molars, with crowns blunted by use and single roots, are set so far within the mouth that they lie partly between the canines, along the border of the palate, which is hollowed out so as to form a groove. The number of these molars may be as low as three in each half of the jaw. In the female the canines are much less developed. In those cases in which the dentition is reduced to the very lowest there are in each half of the jaw only three or four teeth, the first of which, considered to be a premolar, gets worn away on both sides, while the other three, which would thus be regarded as true molars, get worn away obliquely. The milk dentition is more in accordance with the carnivorous type. It exhibits three incisors in each half of the jaw, both above and below, and five molars above as against four below. The incisors gradually disappear. All the transitions between the two extremes may be observed in the dentition according to the age of the individual. The formulas are thus as follows:—

Milk dentition: $\frac{3 \cdot 1 \cdot 5}{3 \cdot 1 \cdot 4} = 34.$

Permanent dentition: $\frac{0 \cdot 1 \cdot 3}{0 \cdot 1 \cdot 2} = 14$ teeth.

The walrus is accordingly a carnivore which has gradually lost its teeth and at the same time had their forms modified through adaptation to a special kind of diet. It feeds, in fact, chiefly on molluscs and sea-urchins, which it digs up from the sea-bottom by means of its tusks. But it does not despise either fish or the flesh of slain whales.

Walruses live in numerous flocks in the neighbourhood of coasts and ice-fields, and only seldom undertake extensive migrations by allowing themselves to be carried away on ice-floes. Sluggish and dull on land, where they nevertheless sometimes betake themselves, raising their bodies by means of their fore-paws or flippers, they are tolerably agile in the water, swimming with great rapidity, diving under the ice, and knocking holes in it from below with their head in order to breathe. They visit the coasts only during and after the melting of the ice, are fond of settling down for a long time in bays where the shallows afford them a rich crop of sand-dwelling molluscs and bivalves.

Furious battles take place between the males in the breeding season. The walruses are advantageously distinguished from other seals by the courage with which they defend themselves against man, by the devotion with which they aid one another, and by the self-sacrificing love with which parents and young ones remain faithful to each other to death. Walruses are hunted very eagerly for the sake of their thick tough skin, their fat, and their tusks, which are estimated at the price of ivory. The hunt is very dangerous. The walrus when pursued, and especially when wounded, endeavours to capsize or shatter the boats with his tusks and fins, and since the others hasten up to the defence of their surprised comrade, terrible encounters ensue, sanguinary both for men and for animals. The bellowing of the enraged walrus is compared to the roaring of a lion. When caught young the walrus becomes attached to man, and it might certainly be tamed if we could furnish it with the necessary means of subsistence. The Eskimo declare that the walruses sometimes have to wage battle against polar bears and killer-whales (*Orca gladiator*), but European observers have not been able to confirm these accounts.

An interesting account of the hunting of the walrus as still pursued by the inhabitants of the north of Norway is given by Weyprecht, one of the leaders of the Austrian polar expedition of 1873–74.

"The true man of the ice," he writes, "is the walrus-hunter. Whatever comes within range of his gun or can be reached by his harpoon, that he carries away with him. He kills the white whale if he finds him, but does not despise even the shark; he shoots the reindeer on the land and fills the empty space with birds' eggs, which lie at his disposal in thousands; he collects eider-down if he has nothing better to do, and salts geese and ducks as a reserve for winter in his home. But his proper booty, that which he always has in his eye, which he pursues as long as he can, and for the sake of which he is ready to risk his life at any time, consists in the walrus, the seal, and the polar bear. Uninterruptedly he searches for traces of them; as soon as the ice is in sight they become for three or four months the goal of his existence, for which he ventures everything—the dream which he pursues night and day.

"The chase demands small, easily managed, and strongly built ships of about the size of our coasters, which can take advantage of every break in the ice, every open channel, to get forward. According as they carry one boat or two they are manned with eight or twelve men, and one or two harpooners, or Fangmänner as they are there called. . . .

"There are two different nationalities which furnish crews for this employment: the blond and more intelligent Norwegian, and the dark-haired Qven, the descendant of the immigrant Russian Finns. . . . A trait which unfortunately characterizes all of them is an extreme indolence, which in the Qven amounts to apathy. For hours together the latter can lie on the same spot or steer to the same point of the compass without giving any indication by his countenance that his mind is occupied with anything at all. In helping to lift a cask of bread on board the *Isbjörn* a Qven got the first joint of one of his fingers smashed, whereupon the captain of his ship cut off the shattered fragment with the blubber-knife. On being asked whether the operation hurt him he calmly replied, 'No!'

"Although not to such a degree as the Qven the Norwegian also possesses a considerable share of listlessness. When a ship is beset by ice all quietly place their hands in their bosoms, and it never occurs to any of them to try to get free by their own exertions. A general holiday prevails, a period of *dolcissimo far niente*, of the most unbounded idleness, which every one takes advantage of as best he can. 'It will soon be all right' is the general motto, and everyone thinks, in saying that, of the favourable wind which in due course will set in and open up the ice. . . .

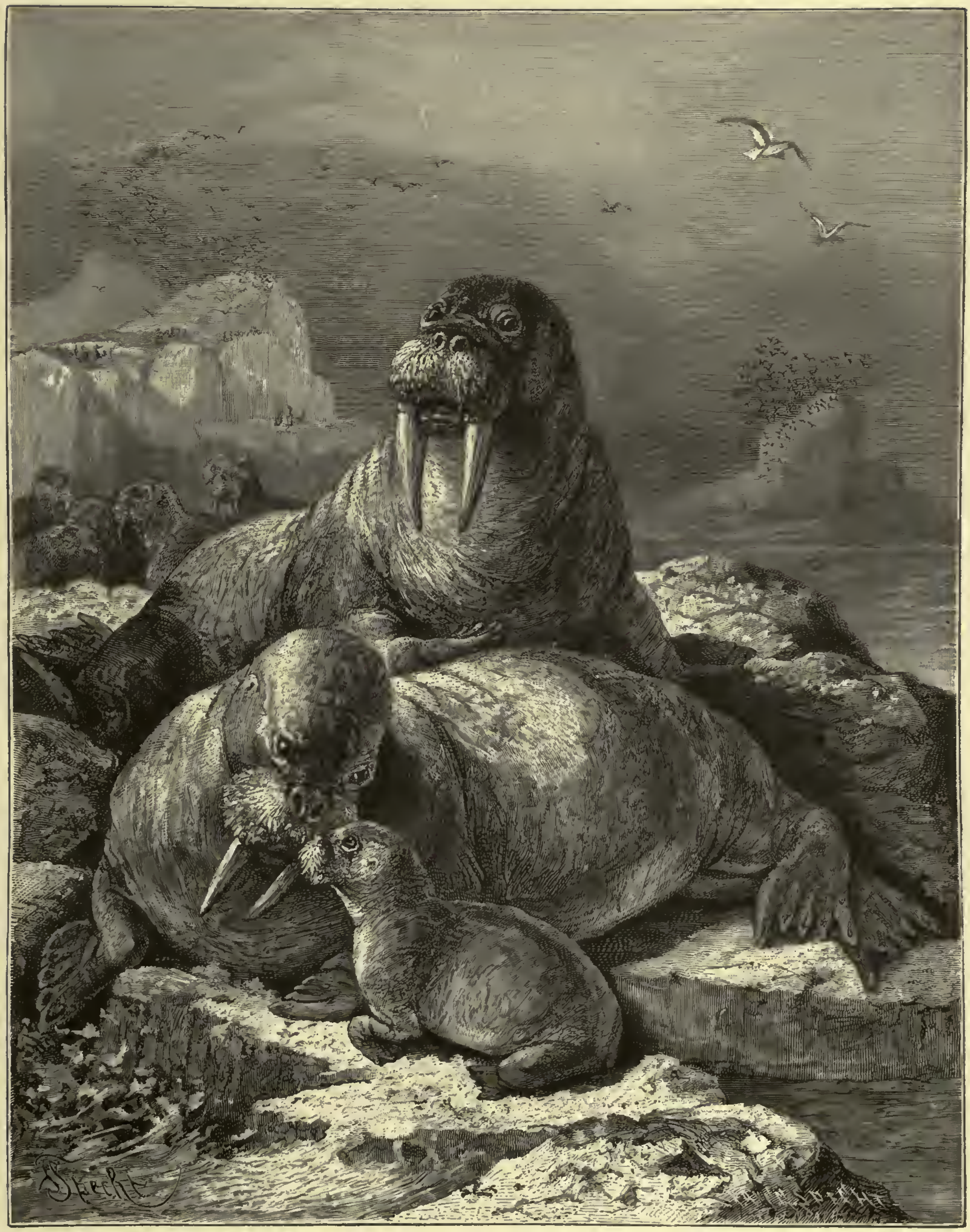
"How completely changed, however, are these same people when they have put off the sailor and put on the hunter. 'A walrus in sight!' resounds from the crow's-nest, and at one blow the sluggish sailor is changed into the bold hunter, the cool shot, the untiring pursuer. The boat's crew pounce upon the boat, which is always kept in perfect readiness. In an instant it is in the water, and, urged by powerful strokes of the oars, is making for the black spot which indicates the booty in the distance. If there is thick ice in the way the whole crew jump out, pull up the boat, and drag it over the floe to the next channel.

"All this is done so rapidly that you fancy you have different men before your eyes. And yet there is no hurrying, everyone performs his task with calmness and without undue haste. Often the boats go many miles in the pursuit, and remain absent from the ship for days; often they are parted by the mists, and do not find each other again till after long searching. Only the captain, the cook, and the cabin-boy then remain on board; how they are to manœuvre the ship is their business. Nobody thinks of that when there is a prospect of a catch.

"If the walrus is sleeping on the ice the boat is almost inaudibly brought so close up to it that the harpooneer can jump on the ice with his long lance and quietly transfix his game, which is quite incapable of offering any resistance when out of the water. If several animals are together and their assailants succeed in killing those nearest the water so speedily that the others cannot reach it, then the victory is secure. The bodies of the slain then form a rampart which these animals, so helpless on the ice, cannot surmount, and the whole herd fall victims to the lance. Such a piece of luck is the great object of desire to the walrus-hunter.

"But the chase assumes quite a different aspect when the animals manage to reach the water in time. They advance curiously up to the unknown object and swim threateningly round the boat. Forward in the prow stands the harpooneer—a harpoon in his right hand ready to strike, five others lying clear beside him so that he can seize them with a rapid snatch. Beside him lie also a rifle and a lance with a heavy wooden shaft, and a double-edged blade a hand-breadth wide and a foot long. Every man at the oars has an axe at his left hand, a long rudely worked blubber-knife on his right.

"The foremost animal is now near enough. With all his strength the hunter plunges the harpoon into his body, rapidly withdraws the long thin shaft, and fastens the end of the harpoon-line to a strong block. The ungainly bleeding animal gives a loud bellow and dives under the water, but the line, from 35 to 40 feet in length, allows him but little play. He soon re-emerges and drags the boat along after him. At the bellowing of their stricken comrade the whole herd become infuriated and make a dash against the weak boat and its occupants. Now here, now there, a colossal shaggy head showing eyes rolling with rage rises in the immediate vicinity and exhibits its tusks a foot long. In blind fury the animals lash the water close by the boat with their huge bodies. The harpooneer meanwhile stands coolly at his post and singles out a second victim—a powerful stroke, and another animal is fastened to the line. The boat now shoots on with doubled speed, leaving a broad wake behind; the furious herd still follows. Often it comes to a close encounter. With the exception of the one who has to steer the boat in the midst of the exciting scene, and on whose coolness and dexterity the life of all depends, every one quits his oar and seizes his knife and axe to defend the slim craft against the furious heads which, always returning, endeavour to strike the boat above the gunwale. It does not occur to any of the animals to make a direct



To face page 252.

PLATE XV. — THE WALRUS OR MORSE (*Trichechus rosmarus*).

LIBRARY
OF THE
UNIVERSITY
OF
CALIFORNIA

thrust against the thin wooden planks; every one of them tries to pierce the gunwale from above with the strongly recurved tusks with which it is accustomed to pull itself forward on the ice. If it should manage to effect this the boat is destroyed at one blow.

"In spite of the struggle going on the harpooneer is ever bent on making new victims. As long as he has a single harpoon free he keeps fastening fresh animals to the line. It sometimes happens that six such monsters are pulling and tugging at the boat at one time, and endeavour to drag it underneath. Only the admirable dexterity and coolness of the steersman, who, in the midst of the exciting scene, dares not allow any movement of the directing harpooneer to escape him, can protect the boat from capsizing.

"Snorting and bellowing with rage the beaten animals surround the boat in ever-widening circles. Not till then does the harpooneer take to his lance. By means of the line he pulls one of the stricken animals, already weakened by the loss of blood, nearer to him, and strikes it on the head with the shaft. As soon as it turns round towards the boat he plunges the lance deep into its breast and thus gives it its death-blow. In this manner he puts them all to death one after the other.

"Such battles take place now only occasionally, for the number of the animals is greatly reduced. Not very long ago there were still so many that when the ship was filled with blubber the hunters continued to slaughter the animals for the sake of the ivory derived from their tusks, and left the dead bodies as a prey to the bears and birds. But even yet a successful hunter may kill from 150 to 200 walruses in a summer."—Weyprecht in *Petermann's Mittheilungen*, November, 1876.

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE SEALS.

The geographical distribution of the Pinnipedia presents a remarkable peculiarity in the presence of seals in basins such as the Caspian Sea, the Sea of Aral, and Lake Baikal, now entirely cut off from the ocean. In general the members of this group inhabit the shores of the ocean and delight in salt water. Yet they ascend a good way up rivers in pursuit of fish, and some are regularly caught every year in Iceland, for example, after following salmon up the rivers. Accordingly it cannot be said that fresh water is a hindrance to their settlement. On the other hand, the first two of the inland basins above mentioned are proved by the character of their fauna otherwise and by the form of the depressions by which they are now separated from the sea, to have been formerly in communication with the waters of the ocean, and have been severed therefrom only by a comparatively recent elevation of the land. The seals have been able to survive this separation all the more easily since the Caspian Sea and the Sea of Aral are both slightly salt and both abound in fish.

Quite different is it with Lake Baikal, which is inhabited by a seal only slightly different from the Greenland seal, and perhaps only a variety of the latter. The water of Lake Baikal is quite fresh. The lake lies in the midst of a mountainous district at the height of more than 1500 feet above sea-level, is surrounded by high mountain peaks, and is separated from the Arctic Ocean in the north of Siberia by a very considerable stretch of land. Even if we assumed that the seals had traversed the plains of Siberia by means of the rivers, there still remained a distance of perhaps 130 miles to cross in the mountains themselves in order to reach the lake. That this was actually accomplished is a supposition hardly credible, and, on the other hand, an elevation of the land so great as to have cut off Lake Baikal from the sea can scarcely be believed to have taken place in quite recent times. All explanations hitherto offered of this remarkable fact appear to be unsatisfactory.

As for the oceanic seals, the facts regarding their distribution are tolerably simple. The animals prefer the coasts of the cold and temperate seas, and in tropical regions are altogether wanting. The walrus is purely Arctic, and transgresses the limit of the

Arctic circle only for a short distance on the cold coasts of North America. The eared seals inhabit in the northern hemisphere only the coasts of the Pacific, from Behring's Strait to Japan on the one side, and to the extremity of California on the other; in the southern hemisphere again they are found on all the Antarctic coasts, and are met with on those of Chile and the states of the Argentine Confederation in America, those of the Cape in Africa, as well as on the shores of Australia and New Zealand. All the shores of the Arctic Ocean and the Atlantic, including the Mediterranean and the Black Sea as well as the inland basins above mentioned, are inhabited only by seals proper, which also extend over nearly the whole of the domain occupied by the eared seals. Only the coasts of Africa and the East Indies are wholly destitute of seals. The seals proper are thus the generally distributed type, while the walruses and eared seals have more limited ranges.

Palæontology sheds but little light on the origin of the seals. Their fossil remains are extremely rare. In the upper Miocene of France remains have been found, with respect to which it is doubtful whether they should be ascribed to eared seals or seals proper. The other Tertiary remains belong indubitably to true seals, and some fragments belonging to walruses have been discovered in the glacial deposits of France and Virginia, accordingly in districts pretty far south.

The affinities connecting the Pinnipedia on the one hand through the structure of the limbs with the sea-otters, on the other through the structure of the skull and teeth with the bears, are most conspicuous in the eared seals. The whole organization, as well as the late appearance of the type in the history of the earth, lead to the presumption that the Pinnipedia represent a branch of the Carnivora which has gradually diverged from the main trunk through undergoing a process of special adaptation to an aquatic life, and which still retains a considerable number of characters belonging to the carnivorous type. The walrus certainly leads to the Sirenia through the remarkable modification of its dentition; but we see in this approximation rather a result of the convergence of characters in types originally distinct brought about by adaptation, than a fact pointing to affinity of stock.

Since organic life in general has raised itself from the depths of the water to the free air, the fact of the adaptation of land animals to an aquatic life would form a remarkable anomaly if we had not a thousand examples to show of retrograde development due to special adaptations. Here this process of degradation is manifested especially in the structure of the teeth and limbs, which remain in a less advanced state of development. The continuance of the pulmonary respiration is, without doubt, a proof of this declension which has affected animals originally terrestrial. It is not at all likely that animals originally aquatic should, while continuing to live in the water, have exchanged the power of breathing by gills for that of breathing by lungs, whereby they are placed at a considerable disadvantage compared with the other inhabitants of the water by the necessity of rising from time to time to the surface. But it would be useless to spin any more speculations of this kind, since, in consequence of the absence of palæontological facts, they lack in a measure a solid foundation.

LIBRARY OF THE UNIVERS... OF CALIFOR...

13 0

BIOLOGY LIBRARY UCB

14 DAY USE
RETURN TO DESK FROM WHICH BORROWED
BIOLOGY LIBRARY
TEL. NO. 642-2532
This book is due on the last date stamped below, or
on the date to which renewed.
Renewed books are subject to immediate recall.

MAR 19 1978	RETURNED TO
Due end of SPRING quarter Subject to recall after —	NOV 14 '80
APR 24 1978	BIOLOGY LIBRARY
DUE	
JAN 9 1978	
Subject to Recall Immediately	
DUE	
JAN - 8 1979	
Subject to Recall Immediately	
DUE	
JAN 7 1981	

Subject to Recall
Immediately

LD21A-6m-1,'75
(S3364s10)476—A-32

General Library
University of California
Berkeley

U.C. BERKELEY LIBRARIES

C039321329